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NEW MALAYAN SPECIES OF *OLIARUS* STÅL (CIXIIDÆ, HOMOPTERA)

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TWO PLATES

The genus *Oliarus* Stål was erected by Stål in 1862, and eight species were placed in it at that time. Since then about one hundred forty species have been included in the genus, and it is now the largest in the family. The present paper adds twenty-three new species. It is strange that several species taken by Wallace in some of the localities from which these specimens came are not among the material; but, after a study of the descriptions by Walker and an examination of such types as are in the British Museum and the Stockholm Museum, I have concluded that the following are undescribed, with one exception.

All of the species dealt with in this paper are typical of the genus. They all possess the median ocellus, and the claval vein ends in the commissure and in no case in the apex or suture of the clavus. The vertex is quadrate with the apex slightly curved (Plate 1, fig. 2*b*), the width of different proportions; in some the width is equal to the length, in others it is considerably less. It is generally widest at the base, but in a few cases it is widest at the apex. There are useful characters in the vertex, but these must be used with discretion, since it shrinks in drying at times, especially in immature specimens. The genus *Urvillea* Kirkaldy represents an extreme, narrow form of vertex, but I cannot recognize this as of generic value, as every degree between it and

the broad form is found. A transverse carina divides the vertex from the frons, but it is obscure in a few forms. From each lateral margin arises a carina which proceeds forward; the two converge and meet in the middle at the apex where they join the transverse carina. Thus two small areas are cut off and I shall call them the areolets (Plate 1, fig. 2b, *ar*). Their shape and size depend upon the point at which the converging carinae arise; when they arise near the apex the areolets are short, and when they leave in the middle or beyond they are long and narrow. In a few cases the converging carinae unite before the apex and join together before uniting with the transverse carina, thus making the areolets four-sided. In a few cases the single partition between the areolets becomes obsolete, leaving an angular transverse carina. In certain other forms, which I shall deal with at a later date as a genus distinct from *Oliarus*, there are no converging carinae but only a single straight carina (apart from the apical transverse carina) across the vertex. A small ridge or carina is sometimes present on the medio-longitudinal basal portion. The frons and clypeus are in one plane, the carinae of the former continuing on to the latter without a break (Plate 1, fig. 2). The sides are curved and the margins form deep carinae or keels which are deepest in the middle. The clypeal suture (Plate 1, fig. 2a, *cs*) which divides the frons from the clypeus is deeply curved, forming a large emargination in the middle of the apex of the frons; this suture is often obscure. The median frontal carina has a small fork at its base and often has a slight break where the median ocellus is situated near the apex. About on a level with the median ocellus on each side there is an oval, translucent area, the fenestra (Plate 1, fig. 2a, *fen*), just in front of the antennae. In an allied genus Distant has described these areas as ocelli, but this is an error. The labium is long, often extending to the apex of the abdomen; the apical segment is always very much longer than wide. The hind legs are strong with two or three strong spines apart from the apical ones. The pronotum is short in the middle, with the hind margin strongly angularly emarginate; the lateral carinae arise in the middle, run along the hind margin for some distance, sometimes contiguous with it, and curve forward and end in the margin behind the eye, practically following the hind margin of the eyes. The mesonotum has five carinae, the two inner lateral ones sometimes being obscure. The tegmina are hyaline, generally clear or with fuscous marks, more rarely colored over the greater por-

tion. The costa coincides with the costal margin, the subcosta and radius are joined together into a stalk, the length of which varies in different species. Mf is slightly before the stigma, the cross veins being near the fork. M_1 and M_2 fork near to mf , M_3 and M_4 forking some considerable way from it; M_{1a} is generally present. Cu_1 forks some way before the apex of clavus but the position varies in different species; Cu_{1a} is always present; Cu_2 forms the claval suture. There are five or six apical cross veins which are not contiguous. The chief difference between *Oliarus* Stål and *Mnemosyne* Stål appears to be that in the latter M_1 and M_2 fork far away from mf and M_3 and M_4 close to mf and there is a M_{4a} . This can be expressed by saying that M_2 had passed over to M_{4a} . The body is considerably flattened horizontally and the tegmina are nearly flat or very obtusely tectiform and the hind margins do not overlap beyond the clavus. The pygofer of the female forms a flat, oval plate, considerably wider than long, the length being measured from the base of the anal segment to the base of the ovipositor; it forms a large surface for the secretion of the wax filaments characteristic of this and some other genera of the family. The anal segment is flat and comparatively thin; its size varies in different species but it is generally fairly or very large, forming a thin disk with rounded sides; the anus is at the apex. The genital styles form an incomplete ovipositor; they are narrow, flat, and pointed, and not coadapted as they are in the complete ovipositor. The seventh abdominal sternite is the pregenital plate, and the shape of the posterior margin offers good specific differences in most species. The male genitalia are of the usual cixiine type. The ædeagus consists of a basal portion, the periandrium, which is mostly tubular or subtubular but sometimes flattened and often bears spines and other processes; the distal portion is the penis and generally consists of a membranous appendage, on which the opening of the ejaculatory duct is situated, as well as one or more spines. It is sometimes difficult to say whether certain spines pertain to the penis or to the apex of the periandrium. The complexity to which the ædeagus often attains is astonishing, and one wonders how it can perform its function with large spines pointing in different directions. Running the length of the periandrium is a chitinous tube, the apodeme of the penis, its base being attached to the apodemes of the genital styles. The ejaculatory duct passes through this apodeme (it may be a strongly chitinized portion of this duct) and continues to the orifice of the penis.

While the chrootic characters are very weak for systematic purposes the genitalia, more especially the ædeagus, are the reverse; for here the difficulty lies in trying to find a relationship between species instead of a difference. It is, therefore, to be regretted that workers have hitherto ignored these organs and confined their descriptions to chrootic characters, mainly to color, and so have produced a set of descriptions which are mainly paraphrases of one another.

Species of this genus are known to live on some economic plants and, although they are seldom if ever numerous enough to do damage, they should not be ignored as they may prove to be vectors of some of the obscure plant diseases.

The types of the species described below have been deposited in the collection of the Hawaiian Sugar Planters' Experiment Station and bear the type numbers of that institution; paratypes when present have been placed in the Baker collection. Measurements are from the apex of head to anus and from the base to apex of one tegmen.

Oliarus hyalinipennis sp. nov. Plate 1, fig. 1.

Male.—Length, 5.5 millimeters; tegmen, 7. Length of vertex equal to width at base; areolets very short, reaching about one-fourth from apex or less. Cu fork slightly basad of Sc + R. Pygofer in ventral view fairly long, medioventral process angular, lateral margins angularly produced; genital styles not produced beyond the margins of pygofer; anal segment fairly long, projecting well beyond pygofer, length about twice the width, apex truncate. Ædeagus fairly simple, periandrium long, narrow, with a small spine on right side about middle; the penis has a strong spine on left side, a shorter and broader one beside it, and a more complex structure partly membranous.

Black or very dark brown, a spot on each side of apex of frons; carinæ of pronotum, tegulæ and apices of femora and tibiæ lighter. Tegmina hyaline, veins dark brown, a light mark at node, ends of apical cells slightly fuscous, veins dark brown. Wings hyaline with dark brown veins, slightly fuscous along apical margin, granules minute, bearing black macrotrichia.

MINDANAO, Kolambugan (*Baker*), 1 male. Type No. 1074.

Oliarus lucidipes sp. nov. Plate 1, figs. 3a and 3b.

Male.—Length, 2.8 millimeters; tegmen, 3.6. Length of vertex about equal to width at base, areolets reaching back about one-fourth from apex, the division between them being obscure

or obsolete, the resulting carina subangular. Cu forking basad of Sc + R. Lateral margins of pygofer slightly arcuate; medio-ventral process narrow, sublanceolate; anal segment projecting considerably beyond pygofer, its length one and one-fourth the width, apex slightly angularly emarginate; genital styles fairly long, reaching well beyond the pygofer nearly to apex of anal segment, apex rounded. Perianthrium fairly small, on the right side produced into a longitudinal ridge, penis with three spines curving to the left, a small round plate at apex and a membranous process. In specimens from Penang Island the flange on the perianthrium is larger and more roundly curved on its outer margin.

Dark brown, carinae of head and pronotum considerably lighter, carinae of mesonotum slightly lighter; coxae and femora brown, tibiae and tarsi whitish; abdomen brown with the hind margins of segments light. Tegmina hyaline, fuscous over the apical half, veins yellowish with minute darker granules, bearing small macrotrichia.

Female.—Length, 3 millimeters; tegmen, 4. In color and general build similar to male. Pygofer much wider than long, suboval; hind margin of pregenital plate slightly sinuate; genital styles not quite as long as pygofer; anal segment small, about half the length of pygofer and about as long as wide.

PENANG, 3 males and 1 female type (*Baker 10058*). BASILAN, 1 male (*Baker 1315*). MINDANAO, Dapitan, 1 male. LUZON, Mount Maquiling, 2 males (*Baker 10067*); Los Baños, 2 males (*Muir*), October, 1915. Type No. 1075.

Oliarus fuscipennis sp. nov.

Female.—Length, 3.4 millimeters; tegmen, 5.2. Length of vertex equal to width; areolets reaching to middle of vertex. Cu fork slightly basad of Sc + R. Pygofer large, anal segment comparatively small, about one-third as wide and about two-thirds the length of pygofer, widest at base, gradually narrowed to apex, sides slightly curved; genital styles not as long as pygofer, narrow; hind margin of pregenital plate truncate.

Dark brown, carinae of head and thorax lighter, tegulae, legs, and abdomen light. Tegmina hyaline suffused with a brownish infuscation; veins light; granules minute, numerous. Wings hyaline, fuscous, with dark veins. Stigma light with a dark mark along inner margin.

EAST JAVA (*Muir*), April, 1914, 1 female. Type No. 1076.

Oliarus flavipes sp. nov. Plate 1, figs. 4a and 4b.

Male.—Length, 4.5 millimeters; tegmen, 5.2. Length of vertex 1.5 times the width at base, narrowest in middle, widest at base; areolets reaching about one-third from apex, the dividing carina between them obsolete. The Cu fork slightly basad of the Sc + R fork.

In color this species is similar to *O. lucidipes*; in the genitalia it differs in the ædeagus. The ridge on the right side of the perianthrium is pointed and there is a fourth spine which is attached to the membranous process.

Female.—Length, 3.6 millimeters; tegmen, 5. The vertex not narrowed across the middle as in the male and the length is equal to the width, but I place it with this species. Anal segment about one-half the length of pygofer and one-eighth the width, sides subparallel, apex truncate; genital style not quite as long as pygofer; hind margin of pregenital plate straight or very slightly curved in middle.

Lighter in color than the male; veins not darker beyond cross veins, granules minute, numerous, bearing light macrotrichia.

LUZON, Mount Maquiling (*Baker 9358*), 1 male (type) and 4 females; Los Baños (*Baker and Muir*), 2 females. This female is closely related to the female of *O. lucidipes* and if it is not the spouse of this species it is closely related to it. Type No. 1077.

Oliarus granulatus sp. nov. Plate 1, figs. 5a and 5b.

Male.—Length, 4 millimeters; tegmen, 5. Vertex slightly longer than wide (1 to 1.2), widest at base which is angularly emarginate; a fine carina runs from middle to base; areolets short, reaching about one-fourth from apex. Forking of Cu and Sc + R about level. Pygofer in ventral view broad and short, medioventral process sublanceolate, apex rounded, lateral margins slightly asymmetrical, angularly produced, the left side more acutely than the right; anal segment large, broader than long, the apex broad and subtruncate. Ædeagus complex; from the base of the perianthrium arise two large processes, the one on the right with an acute apex turned at right angle to body of process; a second spine arises about the middle, the process on left shaped somewhat like a hatchet, with a large spine at the back; from the apical portion, or penis, arise two long, curved spines and a semimembranous process.

Dark brown, carinæ of head and thorax lighter; legs, sterna of abdomen, and pygofer light brown. Tegmina hyaline, veins

light brown or yellow with numerous minute granules slightly darker than the veins, apices of apical vein and the cross veins slightly fuscous. Wings hyaline with brown veins.

Female.—Length, 3.2 millimeters; tegmen, 5.6. In color similar to male. Pygofer wider than long; anal segment comparatively small, smaller than pygofer, wider than long; genital styles about as long as pygofer.

LUZON, Bataan Province, Mount Limay, 1 male (holotype): Laguna Province, Mount Maquiling (*Baker*), 1 female; Los Baños (*Muir*), 1 male and 1 female. Type No. 1078.

Oliarus geniculatus Stål.

This species is represented in the Stockholm Museum by one female, the type. It is very close to *O. longulus*, but the emargination in the middle of the hind margin of the subgenital plate is not so deep and the color of the veins of the tegmina is different. It is best to keep the two species separate until further material can be studied. It is not represented in Baker's collection or my own.

Oliarus longulus sp. nov. Plate 1, figs. 6a, 6b, and 6c.

Male.—Length, 7 millimeters; tegmen, 8. Length of vertex 1.3 times the width at base which is deeply and angularly emarginate, a fine carina running from base to about middle, areolets small, reaching about one-fourth from apex. Forking of Sc + R and Cu about level.

Lateral margins of pygofer projecting considerably with the apex truncate, medioventral process angular and fairly narrow; anal segment large, length more than twice the width, sides arcuate, apex produced into a broad point which is curved ventrad, anus near apex; genital styles comparatively small, with a short, wide hook at the apex. The periandrium is fairly well chitinized with a large, flat, widely diverging furcation on the side, and a large, curved spine on the other side nearer the apex; the penis consists of a membranous funnel and three large spines, two arising on one side of the funnel which are as long as the ædeagus and slender; the third arises on the other side and is thicker and shorter.

Dark brown or black, the carinæ of pronotum lighter, the carinæ of head very slightly lighter, two small, light marks on clypeal suture; legs and tegulæ lighter. Tegmina hyaline, clear or slightly white and opaque, veins dark brown with minute granules bearing small black macrotrichia, stigma brown, apex

bordered with fuscous from stigma to apex of clavus. Wings hyaline, slightly opaque, veins brown, apex narrowly bordered with light fuscous.

Female.—Length, 8 millimeters; tegmen, 9.5. The female differs in color from the male in having the tegmina hyaline slightly tinged with yellow, the veins are dark brown with lighter marks upon them, the mark in the clavus is plainer and extends as an obscure mark to fork of $Sc + R$, the infuscation on apical margin and apical cross veins is broader and darker, but it varies in the three female specimens. The pygofer is large, much wider than long; the anal segment large, thin, as wide as pygofer and slightly longer, oval; genital styles as long as pygofer; the pregenital plate is produced from sides to middle where it is produced into two processes near together, with rounded apices.

MINDANAO, Butuan (*Baker 10043, 17523, 17524*), 1 male and 3 females. Type No. 1079.

Oliarus prolongulus sp. nov.

Female.—In size, build, and color this species is similar to *O. longulus*, but the hind margin of the pregenital plate is truncate and without any processes. That the male will show distinct differences I feel quite sure.

BASILAN (*Baker*), 1 female. Type No. 1080.

Oliarus longicauda sp. nov. Plate 1, figs. 7a and 7b.

Male.—Length, 6.5 millimeters; tegmen, 7. Length of vertex 1.3 times the width at base, widest at base which is deeply and angularly emarginate; a slight carina runs from middle of base to about middle; areolets small, reaching about one-fourth from apex. Forking of $Sc + R$ and Cu about level. Pygofer and anal segment long and narrow, in shape similar to those in *O. longulus*. The ædeagus is quite distinct, the periandrium has a small, bifurcate plate on left side, a small curved spine on right, and a large, strong spine at apex pointing distad; the penis or apical portion of the ædeagus consists of two very long, slender spines and one shorter and stouter spine as well as the membranous portion.

Dark brown or black; the carinæ of head and pronotum lighter and two small light marks on frons at frontoclypeal suture; legs light brown, lighter at apices of femora and tibiæ. Tegmina hyaline, slightly opaque and white, veins dark brown with minute granules; stigma dark brown and a margin of fus-

cous from stigma to apex of clavus. Wings hyaline, slightly whitely opaque, veins dark brown, a slight apical margin of fuscous.

Female.—Length, 8 millimeters; tegmen, 9. The female I associate with this species differs in having the tegmina and wings hyaline slightly tinged with yellow and the veins brown with lighter marks; besides the apical infuscation there is infuscation on the apical cross veins, a small dark spot in clavus slightly beyond the fork of claval veins.

Pygofer large, wider than long, oval, genital styles as long as pygofer; anal segment very large, as wide as pygofer and slightly longer, base narrow. Hind margin of pregenital plate slightly produced from sides to middle where it is produced into two small lobes.

MINDANAO, Surigao (*Baker*), 1 male and 1 female. This species was confused with *O. longulus* until an examination of the ædeagus demonstrated their distinctness. Type No. 1081.

Oliarus walkeri (Stål). Plate 1, figs. 8a, 8b, and 8c.

Cixius walkeri STÅL Freg. Eug. Resa, Ins. (1859) 149, 272.

Male.—Length, 4.2 millimeters; tegmen, 5. Length of vertex about 1.3 times the width at base; areolets long, reaching one-half to two-thirds from apex; the short median carina distinct; base slightly wider than apex. The forking of Cu basad of that of Sc + R. Anal segment slightly longer than wide, sides arcuate, apex slightly emarginate or truncate; lateral margins of pygofer slightly asymmetrical, the right side roundly produced, the left side more squarely. In specimens from Basilan there is a small notch along the upper side of the produced portion near the apex which is missing from specimens from other localities. Genital styles fairly narrow, the apex rounded, produced into a short, thick, curved hook on outer side. Perianthrium thin, tubular, simple; the penis consists of two thin curved spines and a membranous process.

Dark brown; carinæ of head and pronotum yellow or light brown, legs light brown. Tegmina hyaline, veins basad of cross veins yellow, apical of cross veins brown, stigma light brown with a dark inner edge, granules very small and obscure, same color as veins. Wings hyaline with light brown veins.

Female.—Length, 4.8 millimeters; tegmen, 5.7. In general build and color the female is similar to the male. Anal segment slightly longer than wide, about as long as pygofer and about

half the width, broadest near base and gradually narrowing to apex; genital styles nearly as long as pygofer, narrow; hind margin of pregenital plate slightly produced on middle fifth and slightly emarginate in the middle.

BASILAN (*Baker 13345*), 1 male and 1 female. MINDANAO, Surigao, 1 female: Dapitan (*Baker 1316*), 2 females. PALAWAN, Puerto Princesa (*10046, 10048 Baker*), 2 females. SINGAPORE (*10057, 10051, 10049 Baker*), 2 males and 1 female. PENANG (*10053, 10044, 10045 Baker*), 2 males and 6 females. BORNEO, Sandakan, 1 male.

There are some slight differences in both sexes from these localities, but none appears to be sufficient to divide them into two or more species.

The type material in the Stockholm Museum consists of two specimens from Manila, a female, the type, and a specimen without an abdomen, and one male from Malacca. I was not able to examine the genitalia of this specimen to see if it was the same species. There is also one specimen collected by Semper, which cannot belong to the type material.

Oliarus dispar sp. nov. Plate 1, figs. 9a and 9b.

Male.—Length, 4 millimeters; tegmen, 4.3. Length of vertex 1.4 times the width at base; areolets long, reaching about halfway to base. Cu forking basad of Sc+R. Lateral margins of pygofer asymmetrical, the right side produced into a long, thin spine, the left obtuse; length of anal segment 1.4 times the width, subovate, widest about one-third from base. Aedeagus complex, the periandrium with three spines, a small one near base, a longer, curved one about middle, and another from apex; the penis complex with a flat, curved disk at base which is produced into a curved spine; the penis is flat, chitinous on basal half, and membranous beyond with two spines near middle. The flat disk may form part of the periandrium and not the penis. Genital styles with a flattened crook at apex.

Brown, the carinae of head and thorax lighter; legs light. Tegmina hyaline with light brown veins, slightly fuscous at ends of apical veins and on apical cross veins; granules minute, sparse, same color as veins before the cross veins, slightly fuscous apical of cross veins. Wings hyaline with light brown veins.

Female.—Length, 4.6 millimeters; tegmen, 5.2. In color similar to the male. Pygofer short, broad; anal segment about

half as broad as pygofer, base wide, gradually narrowing to apex, about as long as pygofer. Genital styles about as long as pygofer. Hind margin of pregenital segment sinuate, the middle half being slightly produced.

JAVA, Pekalongan (*Muir*), 1907, 2 males and 1 female. Type No. 1082.

Oliarus proprius sp. nov. Plate 2, figs. 10a and 10b.

Male.—Length, 4.4 millimeters; tegmen, 5. Length of vertex about double the width at base; areolets long, narrow, reaching about half the length from apex. Cu forking slightly basad of Sc + R. Lateral margins of pygofer slightly asymmetrical, the left side being produced slightly more than the right, in ventral view pygofer not very long, slightly compressed across middle. Length of anal segment one and one-third times the width, sides arcuate, the apical corners acute and turned under and overlapping. Genital styles long, the apex acute, inner margin convex on apical half, straight on basal half, outer margin concave on apical third where the style is widest, with another concavity on basal two-thirds. The periandrium has three spines: A long, curved spine from near the base on the ventral aspect, a long curved spine from the apical portion on left, and a smaller one on right; the penis is semimembranous with a small spine on the middle and another at the apex.

Dark brown; carinæ of head and pronotum lighter; legs light brown. Tegmina hyaline, slightly yellowish, veins light yellow, slightly brown on apical veins, apical cross veins slightly fuscous, granules minute, sparse, same color as veins. Wings hyaline with brown veins.

JAVA, Buitenzorg (*Muir*), 1 male. Type No. 1083.

Oliarus maculipennis sp. nov. Plate 2, fig. 11.

Male.—Length, 4 millimeters; tegmen, 4.2. Length of vertex about twice the width; areolets narrow reaching back to about the middle. Cu fork slightly basad of Sc + R fork. Pygofer short and broad, sides roundly produced; anal segment slightly longer than broad, sides arcuate, apex narrowly truncate; genital styles small with a short curve at apex; ædeagus simple, the periandrium long, narrow, tubular, without armature, the apical portion membranous; the penis has two fairly strong, curved spines and a membranous appendage.

Vertex, frons, genæ, pronotum, tegulæ, and legs light brown, clypeus and labium dark brown, a small dark mark at base of

frons and on genæ, mesonotum dark brown, lighter on median portion, abdomen light brown with darker marks in middle. Tegmina hyaline with light veins, costa with a series of light and dark marks, granules irregular, sparse, dark brown, bearing black hairs; these give the tegmina an irregular spotted appearance. Wings hyaline with brown veins.

Timor Laut Islands, Larat Island (*Muir*), December, 1907, 1 male. Type No. 1084.

Oliarus brunnifrons sp. nov.

Female.—Length, 6.5 millimeters; tegmen, 7.3. Length of vertex double the width at base; areolets short, reaching one-fifth from apex, four-sided. Cu forking considerably distad of Sc + R fork. Anal segment large, longer than pygofer and about as wide as pygofer, sides rounded; genital styles about as long as pygofer; hind margin of pygofer sinuate, the median portion slightly concave. Head brown, the carinæ darker, the median ocellus yellow; pronotum light; mesonotum dark brown; legs, abdomen, and pygofer brown. Tegmina hyaline; veins brown, Sc beyond fork, the suture, Cu beyond fork, and middle of claval veins lighter; stigma narrow, light; apical cross veins fuscous spreading into membrane, a small fuscous mark on apical radial and two on apical median cells, a dark mark at apex of clavus. Wings hyaline, slightly fuscous, veins brown.

SINGAPORE (*Baker*), 1 female. Type No. 1085.

Oliarus proimpeditus sp. nov. Plate 2, figs. 12a and 12b.

Male.—Length, 3.8 millimeters; tegmen, 4.3. Length of vertex about 1.5 times the width at base; areolets reaching to about middle or slightly beyond. Cu forking considerably nearer the base than Sc + R. In ventral view pygofer long, the lateral margins produced into two subacute, angular processes, the medioventral process long, apex acute. Length of anal segment slightly greater than width, narrowest at base, sides arcuate, apex produced into two rounded lobes which are turned ventrad. Genital styles slender, the apex in shape somewhat like the head of a bird with a thick bill. *Ædeagus* complex; from the left ventrobasal margin of the perianthrium arises a long, flat spinelike process with a pointed apex, the outer margin being membranous; between the outer basal angle of the process and the middle of the left edge of the perianthrium there is an angular membranous process, apical of this

the periandrium narrows considerably; the penis gives rise to three chitinous spines and a membranous process. Head and thorax dark brown or black, carinæ lighter brown; coxæ, femora, and abdomen dark brown, tibiæ and tarsi light. Tegmina hyaline, veins basad of cross veins light brown, veins apical of cross veins darker, granules small, sparse, same color as veins. Wings hyaline with brown veins.

LUZON, Benguet Subprovince, Baguio (*Baker*), 1 male. Type No. 1087.

Oliarus impeditus sp. nov. Plate 2, figs. 13a and 13b.

Male.—Length, 3.4 millimeters, tegmen, 3.6. Length of vertex nearly twice (1.8) the width at base, the areolets reaching to about the middle. Cu forking considerably nearer the base than Sc + R. The lateral margins of the pygofer produced into a pair of pointed processes. Anal segment slightly longer than wide, narrowest at base, sides arcuate; the apex is slightly asymmetrical, angular, and turned under. Genital styles fairly slender, the apex like the head of a bird with a thick, curved beak. Ædeagus complex; the periandrium is broad and flat, the left side is produced into a large, flat process, five or six times longer than wide, with an acute apex; from the middle of the ventral apical margin arises a long, curved, flat, spinelike process, narrowest in middle, with acute apex; five processes arise from the penis, a long, slender curved one with a small one at the base and three smaller ones on the dorsal side.

Head and thorax dark brown or black with the carinæ lighter brown; coxæ and abdomen dark brown, femora, tibiæ, and tarsi light. Tegmina hyaline, veins basad of cross veins light brown, apical of cross veins darker brown, granules small, sparse, same color as veins. Wings hyaline with brown veins.

Female.—In general build and color similar to male. Anal segment about as long as pygofer and one-half as wide, sides rounded, widest near base; genital styles narrow, as long as pygofer; hind margin of pregenital plate truncate.

MINDANAO, Dapitan, (*Baker 10047, 13346*), 2 males and 1 female. Type No. 1087.

Oliarus singularis sp. nov. Plate 2, fig. 14.

Female.—Length, 5.2 millimeters; tegmen, 5.7. Length of vertex 1.7 times the width. Forks of Sc + R and Cu about level or Cu slightly basad. Anal segment two-thirds the width of pygofer, about as long, widest near base, gradually narrow-

ing to apex, sides arcuate; genital styles as long as pygofer, narrow; posterior margin of pregenital plate produced into two acute spines about one-third from the lateral margin, the space between them being roundly emarginate. Head and pronotum light brown, dark in middle of frons, legs light brown, mesonotum dark brown, abdomen lighter brown. Tegmina hyaline with brown veins, granules minute, same color as veins. Wings hyaline with brown veins.

JAVA, Roban (*Muir*), 1 female. Type No. 1088.

Oliarus bakeri sp. nov.

Female.—Length, 5.3 millimeters; tegmen, 6.3. Length of vertex 2.5 times the width at base; areolets long and very narrow, reaching about halfway to base; mediolongitudinal carina very short, obscure. The Cu fork considerably nearer base than that of Sc + R. Hind margin of pregenital plate nearly straight, a very small, shallow emargination in middle with the corners of the emargination very slightly produced; pygofer oval, one-third wider than long; anal segment about as long as pygofer and about half the width, oval; genital styles not quite as long as pygofer.

Head, pronotum, tibiae, tarsi, and tegulae light brown, slightly darker on face between carinae, apex of clypeus dark; mesonotum dark brown or black; coxae, femora, and abdomen dark brown, margins of abdominal segments light. Tegmina hyaline, shiny, dark brown with a white subcrescent-shaped mark on costa extending from about one-third from base of costa to the stigma and reaching back to the basal portion of R beyond the fork; veins same color as membrane but darker, granules numerous, minute, bearing small, black macrotrichia. Wings brown with darker veins, a small white mark on middle of costa.

BORNEO, Sandakan (*Baker*), 1 female. This species is very distinctly colored. Type No. 1089.

Oliarus pallidifrons sp. nov. Plate 2, fig. 15.

Male.—Length, 5.2 millimeters; tegmen, 5.5. Length of vertex 2.6 times the width; base angularly emarginate, apex slightly curved, areolets small reaching about one-fourth from apex. Cu forking considerably before Sc + R. Length of anal segment about double the width, sides arcuate, apex truncate, anus at apex; lateral margins of pygofer angularly produced with the apex curved slightly upward, medioventral

process small, rounded; genital styles in flat view curved at apex with the inner corner produced into a small process, the outer corner angular, a small triangular process on the inner surface. *Ædeagus* complex without any good demarcation between perianthrium and penis; there is one broad process whose apex is produced into two curved spines, one strong, long spine as long as the *ædeagus*, a small spine near base, and another about half the length of the *ædeagus*.

Vertex and mesonotum dark brown or nearly black, pronotum, frons, and clypeus lighter, coxæ and pleura of thorax dark brown, legs light brown. Tegmina hyaline, slightly tinged with yellow, veins basad of cross veins yellow or light brown, distad of cross veins dark brown; slightly fuscous at apex of clavus and over apical cross veins; granules very small, bearing small, black macrotrichia.

LUZON, Los Baños (*Muir*), September, 1915, 2 males. Type No. 1090.

Oliarus bilineatus sp. nov. Plate 2, figs. 16a and 16b.

Male.—Length, 4 millimeters; tegmen, 5. Length of vertex about three and one-half times the width, slightly wider at apex than at base, base deeply and angularly emarginate, apex projecting slightly in front of eyes, slightly curved, areolets narrow, reaching about one-third from apex. Cu fork slightly basad of Sc + R fork.

Width of anal segment about two-thirds the length, the lateral margins curved down at apex where they meet in the middle line; medioventral process of pygofer lanceolate with a thick base, sides of pygofer slightly curved with a small angular projection at anal angle. Genital styles in ventral view reaching beyond pygofer, apices curved, widest on basal half. *Ædeagus* fairly large, perianthrium moderately short and broad with a large, rounded projection on side on basal half, a strong, curved spine on the left side near apex and another on right side; the penis mostly membranous with two large, curved spines at the apex.

Castaneous; carinæ of head and thorax lighter, lighter between the lateral carinæ of mesonotum forming two light lines down the thorax; legs lighter. Tegmina hyaline, very slightly tinged with yellow; veins yellow or light brown; the claval margin, cross veins, apical cross veins and apical veins darker; granules same color as veins, sparse, bearing black macrotrichia.

There is a very slight infuscation on the apical margins of the apical cells. Wings hyaline, veins brown, a slight infuscation on the apical margin.

Female.—Length, 4.3 millimeters; tegmen, 5.3. In build and color similar to male. Pygofer much wider than long; anal segment as long as pygofer, not quite so wide, sides rounded; genital styles about as long as pygofer; hind margin of pre-genital plate straight.

Timor Laut Islands, Larat Island (*Muir*), 1907, 1 male and 2 females. Type No. 1091.

Oliarus acuminatus sp. nov. Plate 2, figs. 17a and 17b.

Male.—Length, 3.7 millimeters; tegmen, 4.5. Length of vertex three times the width, areolets long and narrow, reaching two-thirds from apex. Forking of Cu slightly basad of Sc + R. Pygofer in ventral view wide, flat, and short, medio-ventral process acute; anal segment longer than wide (1.3 to 1), sides arcuate, apex acute, turned ventrad and slightly under, when at rest genital styles reaching the turned-down apex of anal segment; periandrium long and thin without any processes, the penis consisting of four spines and a membranous process which are best understood by a study of the figure.

Head and pronotum light brown, the apex of clypeus dark, the lateral carinae of frons sometimes tinged with green, mesonotum darker brown, lighter between the outer carinae, legs light brown. Tegmina hyaline with brown veins which are darker apical of cross veins, granules minute, numerous, bearing small brown macrotrichia; stigma brown, slightly fuscous over apical cross veins, apical veins slightly thickened.

Female.—Length, 4 millimeters; tegmen, 5.3. In build and color similar to male. Pygofer wider than long, anal segment much narrower than pygofer, oval; genital styles about as long as pygofer; hind margin of pregenital plate truncate.

Timor Laut Islands, Larat Island (*Muir*), December, 1907, 3 males and 4 females. Type No. 1092.

Oliarus albomaculata sp. nov.

Female.—Length, 7 millimeters; tegmen, 8. Length of face three times the width at apex, widest at apex; areolets long and narrow, reaching about to middle. Forking of Cu and Sc + R about level. Pygofer wider than long, anal segment as long as pygofer, broadest at basal third where it is about half the width of pygofer, gradually narrowing to apex; hind

margin of pregenital plate angularly produced in the middle, the apex of the produced part having a minute indentation; genital styles much longer than the pygofer.

Head, thorax, and abdomen brown, frons slightly darker than clypeus, a white or yellowish white mark from fenestra to the clypeal suture and touching the lateral margin; mesonotum darker over the median carina and on lateral portions; legs light brown. Tegmina hyaline; Sc + R stalk, subcosta to stigma, Cu beyond fork, and suture yellow, R, M to cross veins and Cu to cross veins dark brown, apical veins brownish, base and apex of clavus, cross and apical cross veins fuscous. Wings hyaline, veins brown.

LUZON, Los Baños (*Muir*), September, 1915, 1 female (holotype); Mount Maquiling (*Baker 9355, 9356*), 4 females. In one specimen the infuscation at apex of clavus extends as a faint band to costa. This species is near to *O. borneensis* so far as the females are concerned. Type No. 1093.

Oliarus borneensis sp. nov. Plate 2, fig. 18.

Male.—Length, 6 millimeters; tegmen, 6.4. Length of vertex slightly more than twice the width at base; areolets long and narrow, reaching halfway from apex. Forking of Cu and Sc + R level. The right lateral margin of pygofer more angularly produced than the left; length of anal segment 1.5 times the width, the apex truncate with middle of the margin produced into a small process turned ventrad, the apex of the process being slightly emarginate; genital styles small, the apex hatchet-shaped. *Æ*deagus with a simple periandrium; the penis bears two spines, one a long, slender one with a twist about one-third of apex, and the other forming a complete spiral around the membranous process.

Dark brown; carinae of head and thorax and the legs lighter. Tegmina hyaline, veins brown, slightly infuscate over the apices of apical cells and over apical cross veins. Wings hyaline, veins brown.

Female.—Length, 4.8 millimeters; tegmen, 6.2. In color similar to male but the infuscation in apical cells slightly darker. Pygofer longer than broad, oval; anal segment as long as pygofer, longer than broad; genital styles as long as pygofer; pregenital plate with posterior margin truncate.

BORNEO, Sandakan (*Baker 10052*), 1 male and 1 female. There is one female from Surigao, Mindanao, which I place with this species, but not with the type series. Type No. 1094.

Oliarus exiguus sp. nov. Plate 2, fig. 19.

Male.—Length, 4.4 millimeters; tegmen, 5.4. Length of vertex 3.6 times the width; areolets long and narrow, reaching one-third or more from apex. Forking of Cu and Sc + R level. In ventral view pygofer fairly long, anal segment projecting about one-third beyond pygofer; lateral margins of pygofer produced bluntly, a little asymmetrical, the right being less truncate than the left; width of anal segment two-thirds the length, apex slightly angularly emarginate. The ædeagus is complex; the periandrium is fairly large with two large spines on the left side near base, the shorter one being broad; the penis has three spines, one very long, thin, and curved, the second not so long, and the third smaller.

Dark brown or black, carinæ of head and pronotum lighter, legs lighter brown, abdomen and genitalia dark brown with the hind margins of segments light. Tegmina hyaline, veins brown, granules minute, bearing small black macrotrichia, slightly fuscous over apical cross veins. Wings hyaline with brown veins.

SINGAPORE (*Baker 10055*), 2 males. Type No. 1095.

Oliarus laratensis sp. nov. Plate 2, figs. 20a and 20b.

Male.—Length, 6 millimeters; tegmen, 7. Length of vertex four times the width, base deeply and angularly emarginate; areolets very short, reaching about one-eighth to one-ninth from apex, nearly as broad as long. Cu forking considerably before Sc + R fork. In ventral view pygofer and anal segment fairly long, anal segment reaching a little beyond pygofer, genital styles nearly reaching apex of anal segment; length of anal segment about one and a half times the width, apex truncate; lateral margin of pygofer angularly produced; genital styles in flat view fairly narrow, inner margin slightly sinuous, angular at apex; from the inner surface near apex arises a long, slender spine. Periandrium small and simple, penis complex, consisting of a large, flat, subcrescent-shaped plate, a strong curved spine from near the base, and a complex semimembranous construction supported by chitinizations.

Vertex dark brown; frons, clypeus, pronotum, and legs light brown or yellow, mesonotum dark brown, lighter between outer carinæ. Tegmina hyaline, very slightly opaquely white, veins dark brown, lighter in middle of Sc + R stalk and on apical portion of claval margin, granules minute and numerous, bearing small, black macrotrichia, stigma brown, a small fuscous

mark on apical R, M_1 and Cu_{1a} also slightly over apical cross veins. Wings hyaline, veins brown, narrowly and slightly fuscous along apical margin.

Female.—Length, 6 millimeters; tegmen, 7.3. In general build and color similar to male. Pygofer much wider than long, oval; anal segment at base as broad as pygofer narrowing to apex, slightly longer than pygofer, genital styles slightly longer than pygofer, broad at base, anterior styles nearly as long as posterior; hind margin of pregenital plate slightly and roundly produced in middle.

Timor Laut Islands, Larat Island (*Muir*), December, 1907, 4 males and 6 females. Type No. 1096.

ILLUSTRATIONS

PLATE 1

- FIG. 1. *Oliarus hyalinipennis* sp. nov.; male genitalia, left lateral view, $\times 25$.
2. *Oliarus* sp.; *a*, frons and clypeus, front view; *fen*, fenestra; *cs*, clypeal suture; *b*, vertex; *ar*, areolet.
3. *Oliarus lucidipes* sp. nov.; *a*, male genitalia, ventral view; *b*, ædeagus, left lateral view, $\times 25$.
4. *Oliarus flavipes* sp. nov.; *a*, male genitalia, left lateral view; *b*, ventral view, $\times 25$.
5. *Oliarus granulatus* sp. nov.; *a*, male genitalia, ventral view; *b*, ædeagus, ventral view, $\times 25$.
6. *Oliarus longulus* sp. nov.; *a*, male genitalia with ædeagus dissected away, right lateral view, $\times 12$; *b*, ædeagus, left lateral view, $\times 25$; *c*, female pregenital plate, posterior margin, $\times 12$.
7. *Oliarus longicauda* sp. nov.; *a*, male genitalia, ventral view, $\times 12$; *b*, female pregenital plate, posterior margin, $\times 12$.
8. *Oliarus walkeri* (Stål); *a*, male genitalia, left lateral view, $\times 25$; *b*, apex of ædeagus, ventral view; *c*, female pregenital plate, posterior margin.
9. *Oliarus dispar* sp. nov.; *a*, male genitalia, ventral view, $\times 25$; *b*, ædeagus, ventral view.

PLATE 2

- FIG. 10. *Oliarus proprius* sp. nov.; *a*, male genitalia, ventral view, $\times 25$; *b*, ædeagus, ventral view, $\times 25$.
11. *Oliarus maculipennis* sp. nov.; ædeagus, right lateral view, $\times 50$.
12. *Oliarus proimpeditus* sp. nov.; *a*, male genitalia, ventral view, $\times 25$; *b*, ædeagus, ventral view.
13. *Oliarus impeditus* sp. nov.; *a*, male genitalia, ventral view, $\times 25$; *b*, ædeagus, ventral view, $\times 50$.
14. *Oliarus singularis* sp. nov.; female pregenital plate, posterior margin.
15. *Oliarus pallidifrons* sp. nov.; male genitalia, right lateral view, $\times 25$.
16. *Oliarus bilineatus* sp. nov.; *a*, male genitalia, left lateral view, $\times 25$; *b*, ventral view, $\times 25$.
17. *Oliarus acuminatus* sp. nov.; *a*, male genitalia, ventral view, $\times 50$; *b*, ædeagus, left lateral view, $\times 50$.
18. *Oliarus borneensis* sp. nov.; male genitalia, left lateral view, $\times 25$.
19. *Oliarus exiguus* sp. nov.; male genitalia, left lateral view, $\times 25$.
20. *Oliarus laratensis* sp. nov.; *a*, male genitalia with ædeagus dissected out, left lateral view, $\times 25$; *b*, ædeagus, left lateral view, $\times 25$.

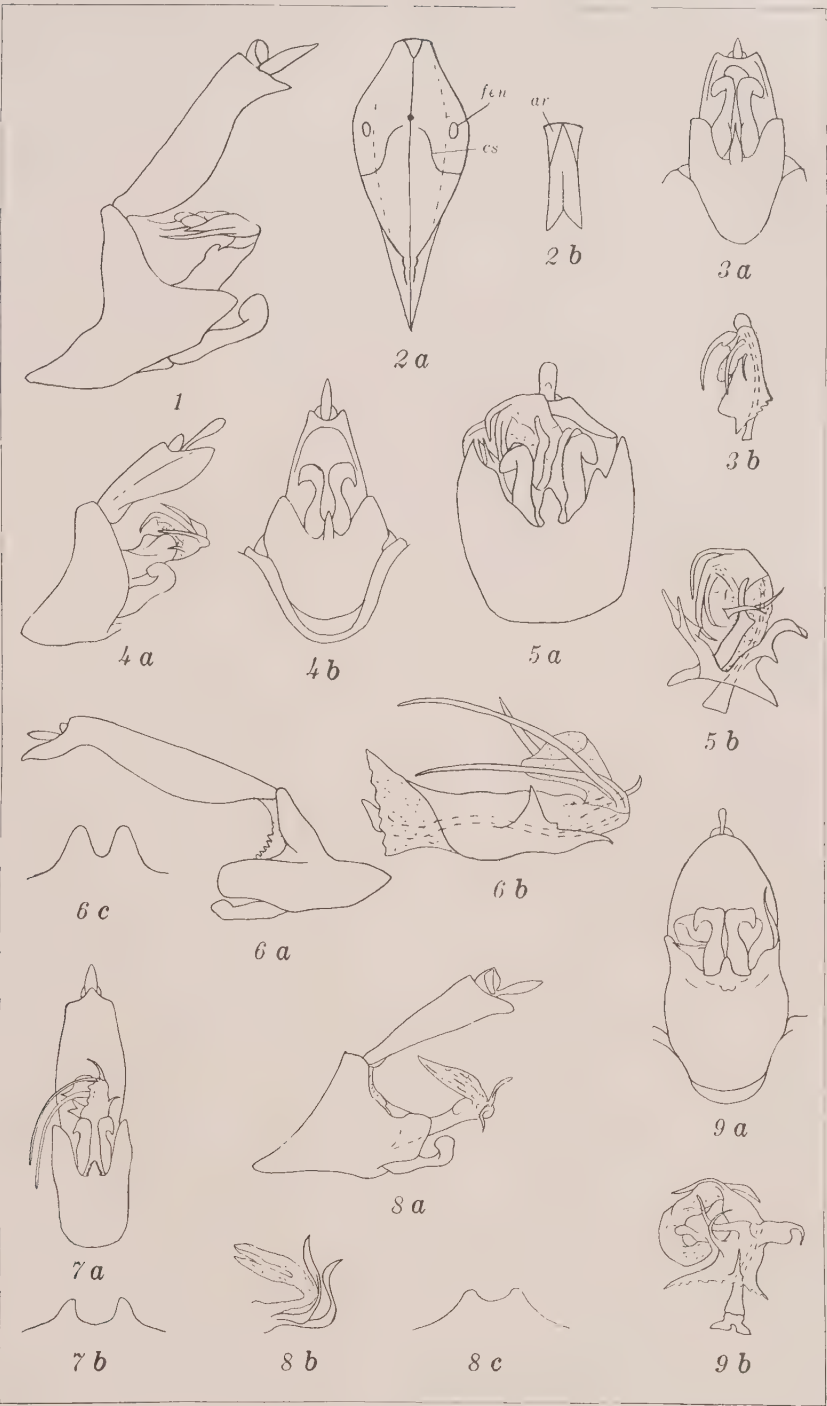


PLATE 1.

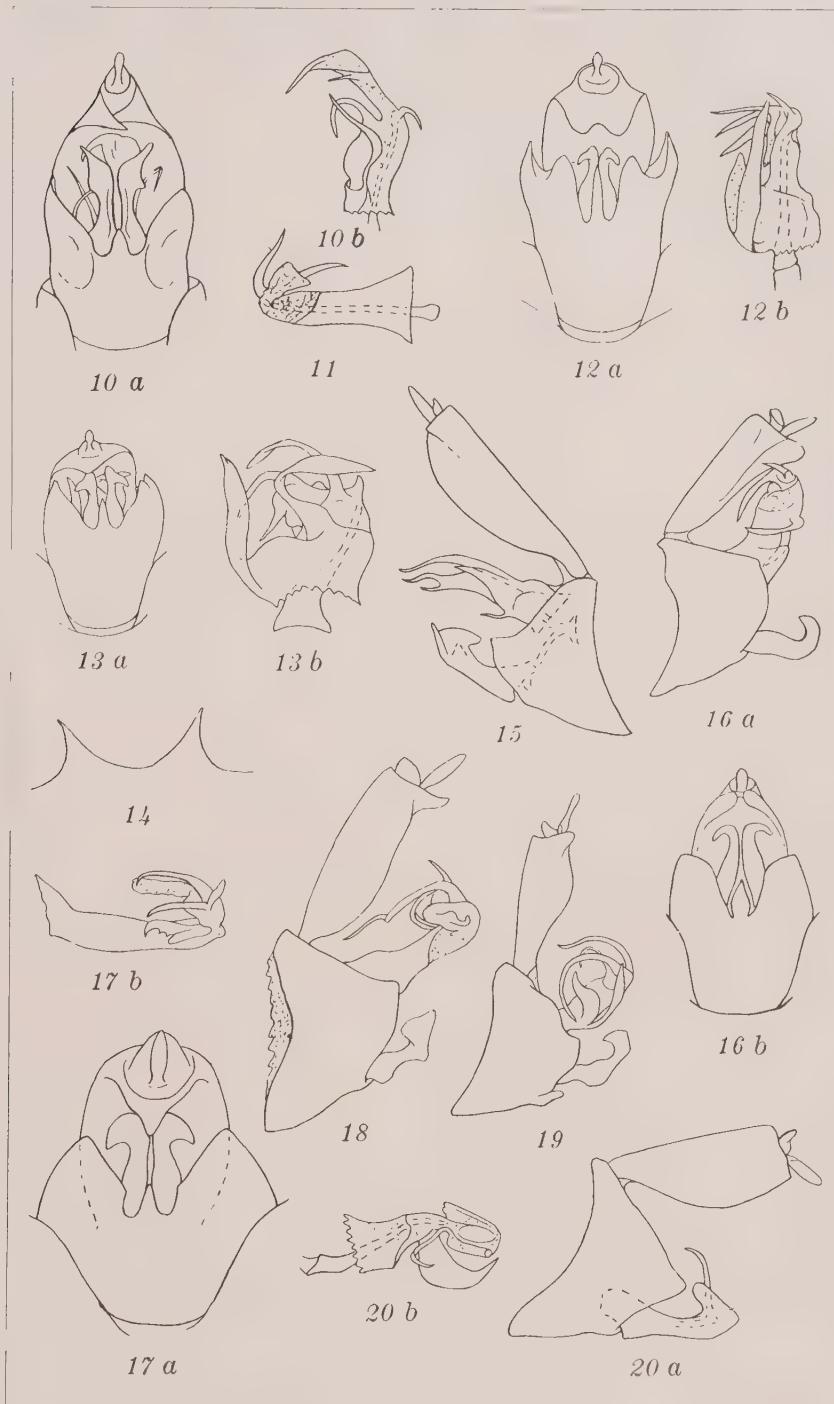


PLATE 2.

NEW OR LITTLE-KNOWN CRANE FLIES FROM NORTHERN JAPAN (TIPULIDÆ, DIPTERA)

By CHARLES P. ALEXANDER
*Of Amherst, Massachusetts*¹

TWO PLATES

During the summer of 1922, Teiso Esaki undertook an extensive collecting trip through Japanese Saghalien (Karafuto) and Hokkaido. Through the kind interest of Doctor Esaki, I have received the very extensive collections of Tipuloidea secured upon this expedition, these including more than one hundred species. It is no exaggeration to state that this is the largest and finest collection of crane flies that has yet been taken in Japan.

The species of Tipuloidea inhabiting Japan include a very curious admixture of forms that show affinities with others inhabiting the western Palæarctic, the Nearctic, and the Oriental Regions, as well as a small proportion of endemic genera and subgenera, though with an abundance of endemic species. This relationship is discussed in greater detail in the present paper. I am vastly indebted to Doctor Esaki for the gift of this splendid collection and for the accompanying discussion of his itinerary. All types and uniques are preserved in my collection, but certain paratypes and duplicates have been returned to Doctor Esaki.

GENERAL ACCOUNT OF THE EXPEDITION BY DOCTOR ESAKI

Saghalien.—Toyohara is the principal town of the island, located on the River Suzuya. To the east of the town there are small mountains of less than 500 feet in altitude, while east of these there is an extensive mountain range that averages more than 3,000 feet in altitude, culminating in Mount Suzuya, 3,454 feet, lying just east of Toyohara. These mountains are covered by coniferous forests, of which *Picea ajanensis* and *Abies sachalinensis* are the chief components. These two species are also found in Hokkaido, where they reach their southern limits. Crane flies appeared to be rather scarce in these mountains. Most of those from Toyohara were collected among the bushes along the river west of the town. Large trees

¹ Contribution from the Department of Entomology, Massachusetts Agricultural College.

are not plentiful there, the majority being trees of medium height, among them the following genera: *Betula*, *Alnus*, *Populus*, *Salix*, and *Ulmus*, lesser numbers of species of *Fagus* and *Quercus*, and a greatly reduced number of conifers, *Abies*, *Picea*, and *Larix*. The country is frequently swampy and the shrubs grow to a rather greater height than in Honshiu. A part of these flies were captured at light and at honey bait-traps.

Konuma lies about five miles north of Toyohara and under almost the same conditions, but the fauna seems more plentiful.

Sakaehama lies along the shore, the soil being mostly sandy, and the fauna and flora are very poor.

From Takinosawa to Shimizu (altitude about 1,000 feet) there was found a very abundant fauna, especially in butterflies. Unfortunately only a few tipulids were secured here. You probably found four examples of a medium-sized tipulid from Shimizu, whose wings are beautifully colored with hyaline and brown markings (*Polyangaeus gloriosus* sp. n.). This species was found near a valley where they fly in the evening, appearing as if entangled with one another.

The western coast of Saghalien (Honto, north to Kusunnai at 48° N. lat.) supports a very poor fauna, not only in crane flies but in almost all other groups.

From Kusunnai to Manui (northern limit reached by the expedition) the altitude is not so high as at Takinosawa (about 800 feet at Todoro-kitōge). Unfortunately while I was there the weather was inclement and collections here were not extensive. A destructive forest fire of a half century or more ago destroyed most of the larger trees, so that now there are only small specimens, mostly of *Betula alba*.

The eastern coast of Saghalien (Manui to Tonnai) is much richer in its fauna than the western coast. There are many marshes and pools along the coast but collecting is often interfered with by the windy weather. From Odomari to Tonnai (southeastern peninsula of Saghalien), we pass through extensive forests of *Abies* and *Picea*. These forests are severely attacked by a lasiocampid moth, *Dendrolimus sibiricus*, which has killed off a part of the trees.

Hokkaido.—Sapporo is the capital of Hokkaido, lying in the center of the Plain of Ishikari. In summer we have an abundant fauna, not only in the vicinity of the city, but within the city limits as well. Maruyama, just west of the city, is a most excellent collecting ground. The environment is very like that of Mount Minomo, in Settsu-no-kuni, central Honshiu, the streams in both cases being shaded by dense leafy shrubbery. Mount Moiwa, although at a higher altitude than Maruyama, seems to support a poorer fauna. The only tipulid collected there is a new species (*Discobola moiwana* sp. n.).

Jozankei is one of the best-known collecting grounds in all Japan. It is a bathing resort and has been much invaded by civilization within recent years, so its fauna is gradually becoming reduced. The vegetation along the valley is very dense. Kamuikotan, along the river Ishikari, is also a famous collecting spot in Japan, but the fauna is not so abundant as at Jozankei. Kamiotoineppu, in northern Teshio, proved to be a most excellent collecting ground. The extensive Experimental Forest of the Hokkaido Imperial University is located here. Most of the crane flies from this place were swept from trees and shrubs with spatulate leaves.

The very long-beaked species (*Elephantomyia hokkaidensis* sp. n.) which was afterwards found in many stations in Hokkaido, was found on the flowers of Compositæ, on which many insects, e. g., Syrphidæ, Apidæ, Lycaenidæ, and Hesperidæ, were feeding. This was true for all specimens collected, with the exception of a few that were attracted to light. No specimens were found on other flowers.

Shikaripetsu (Teshio) and Kamiokoppe (Kitami) are on the two sides of the boundary between Teshio and Kitami. The conditions are very similar to those obtaining at Kamiotoineppu (all being mountainous but not exceeding 1,000 feet in altitude), but the fauna is much poorer.

Abashiri (Northeastern Kitami) provides excellent collecting grounds in the vicinity of the town. Specimens dated August 30th were collected on Mount Sanchozan, at an altitude of 500 feet or more, about two miles northwest of the town, and in the Abies forests at Moyoro at night [a pair of the large and beautiful *Pedicia daimio* (Matsumura), a single *Nesopeza geniculata* Alexander, and *Elephantomyia hokkaidensis* were captured here at light]. The collection dated August 31st is from the town proper.

Akan is the name of a lake in the northern extremity of the Province of Kushiro. It is one of the most interesting and beautiful lakes in Hokkaido, or even in all Japan, but it is very inconvenient to visit there. The fauna is probably a very rich one although the season during which my trip was made was not a good one. In the lake can be seen a very curious alga, *Ægagropila sauteri*, about the shape and size of a base-ball, which is spread over the bottom of a part of the lake and can be clearly

TABLE 1.—Stations at which collections of *Tipulidæ* were made.

SAGHALIEN

Japanese name.	Russian name.	Approximate location.	Approximate altitude in feet.
Higashi-shiraura.....	Shiraraka.....	East.....	Sea level.
Honto.....		West.....	Do.
Kawakami.....		South.....	Less than 500.
Kiminai.....	Kimnai.....	do.....	Less than 800.
Konuma.....	Novalexandrovska.....	do.....	Very low.
Kusunnai.....		West.....	Sea level.
Manui.....		East.....	Do.
Maoka.....	Mauka.....	West.....	Do.
Minakishi.....		South.....	Low.
Nayoro.....		West.....	Sea level.
Nodasam.....		do.....	Do.
Ochiho.....		South.....	Do.
Odasam.....		East.....	Do.
Odomari.....	Korsakoff.....	South.....	Do.
Oite.....		West.....	Sea level.
Sakaehama.....		East.....	Do.
Shimizu.....		South.....	About 1,000.
Takinosawa.....		do.....	Do.
Todorokitōge.....		North.....	About 800.
Tomarioro.....		West.....	Sea level.
Tonnai.....	Tonnaitcha.....	South.....	Do.
Toyohara.....	Vladimirofka.....	do.....	Very low.

TABLE 1.—Stations at which collections of *Tipulidæ* were made—Continued.

HOKKAIDO

Station.	Province (Ken).	Approximate altitude in feet.
Abashiri.....	Kitami.....	Sea level.
Akan (lake).....	Kushiro.....	1,400.
Akkeshi.....	do.....	Sea level.
Biporo.....	Kitami.....	Very low.
Hakodate.....	Oshima.....	Sea level.
Jozankei.....	Ishikari.....	About 1,000.
Kamiokoppe.....	Kitami.....	Less than 1,000.
Kamiotoineppu.....	Teshio.....	Do.
Kamuikotan.....	Ishikari.....	About 800.
Kushiro.....	Kushiro.....	Sea level.
Kutchan.....	Iburi.....	Very low.
Maruyama.....	Ishikari.....	750.
Meakantake (volcano).....	Kushiro.....	5,340.
Moiwa (Mount).....	Ishikari.....	1,750.
Nayoro.....	Teshio.....	Low.
Nokkeushi.....	Kitami.....	Very low.
Onuma.....	Oshima.....	Do.
Otanoshike.....	Kushiro.....	Sea level.
Panketo.....	do.....	1,500.
Ponkikin.....	Kitami.....	Less than 500.
Sapporo.....	Ishikari.....	60.
Shikaripetsu.....	Teshio.....	Less than 1,000.
Shikotsu (lake).....	Iburi.....	850.
Shitakara.....	Kushiro.....	Less than 500.
Teppetsu.....	do.....	Do.
Tomakomai.....	Iburi.....	Sea level.
Tsubetsu.....	Kitami.....	Less than 500.

seen through the very limpid water. (The stations Biporo, Tsubetsu, Ponkikin (Kitami), Panketo, Teppetsu, Shitakara, Otanoshike and Kushiro (Kushiro) are in the eastern part of Hokkaido).

Kushiro and Akkeshi are on the southeastern coast and the weather is very frequently misty. They do not support a rich fauna. Shikotsu (in Iburi) is likewise a very famous lake in Hokkaido. The water is even clearer than that of Lake Akan. The margins of the lake are covered with very rich vegetation which afford really excellent collecting.

COMPONENTS OF THE CRANE-FLY FAUNA OF NORTHERN JAPAN

The majority of the genera and species of crane flies so far discovered in northern Japan are evidently derived from, or find their closest relatives in, the Holarctic Region. However, a certain considerable proportion have evidently been derived from the west (Europe) while others are as clearly derived from the east (North America). In addition to the above, and to numerous endemic species, there has been a notable invasion of genera and species from the south, though many of these oriental types do not reach the northern island of Japan (*Thrypti-*

comya, *Euglochina*, *Styringomyia*, *Gymnastes*, *Trentepohlia*, *Ctenacroscelis*, *Tipulodina*, and others) but reach their northern limit at about the latitude of Tokyo, or slightly farther north in Honshiu.

With the above facts in mind, the Tipuloidea that were taken by Doctor Esaki may be roughly divided into the following groups:

1. *Endemic groups.*

Proantocha, a subgenus.

Tipulidæ, most of the species of this family, in various genera.

2. *Genera and species evidently derived from the western Palearctic Region.*

Dicranomyia megacauda sp. nov.

Erioptera (Acyphona) yezoana sp. nov.

Limonia quadrinotata (Meigen).

Cheilotrichia imbuta (Meigen).

Limonia annulus truncata subsp. nov.

Nephrotoma dorsalis sachalina subsp. nov.

Limonia bifasciata avis Alexander.

Nephrotoma aculeata atricauda subsp. nov.

Limnophila japonica Alexander.

Nephrotoma cornicina Linnæus var.

Limnophila nemoralis (Meigen) var.

Nephrotoma lamellata Riedel var.

Erioptera (Acyphona) sachalina sp. nov.

The genera *Psiloconopa* and *Dictenidia* in Honshiu also show this relationship.

3. *Genera and species evidently derived from the Nearctic Region.*

Dicranomyia globulithorax sp. nov.

Eriocera jozana sp. nov.

Discobola moiwana sp. nov.

Erioptera (Hoplolabis) asiatica Alexander.

Discobola argus (Say).

Ormosia subdeviata sp. nov.

Limonia neoindigena sp. nov.

Gnophomyia tristis sp. nov.

Rhaphidolabina.

Neolimnophila ultima (Osten Sacken) var.

Polyangæus.

Eriocera sachalinensis sp. nov.

Oropeza satsuma Alexander.

4. *Genus evidently derived from the Neotropical Region.*

Paratropesa esakii sp. nov.

5. *Genera and species evidently derived from the Oriental Region.*

Rhipidia pulchra septentrionis Alexander.

Gonomyia (Lipophleps) flavocostalis sp. nov.

Libnotes longistigma Alexander.

Conosia irrorata (Wiedemann).

Libnotes nokirai Alexander.

Nesopeza geniculata Alexander.

Tipula nova Walker.

6. *Holarctic types.*

Rhipidia maculata Meigen.

Ula.

Dicranomyia longipennis (Schummel).

Acyphona.

Helobia hybrida Meigen.

Elliptera.

Tanyptera.

Pedicia.

Ctenophora.

From the above data it can readily be seen that the chief affinities of the tipulid fauna of northern Japan are with other parts of the Holarctic Region. A concrete comparison of the known Tipulidæ of three widely separated localities in the Holarctic Region has been tabulated. These regions are northern Japan (Saghalien and Hokkaido), in the eastern Palæarctic Region; Lapland, in the western Palæarctic Region; and the State of Maine in the northeastern Nearctic Region.

TABLE 2.—Comparison of known Tipulidæ in three widely separated localities in the Holarctic Region.

[An asterisk indicates that the genus has been taken in Honshiu, although not known to occur in the northern island of Japan.]

Genus.	North- ern Japan.	Lap- land.	Maine.	Genus.	North- ern Japan.	Lap- land.	Maine.
<i>Ptychoptera</i>	1	0	1	<i>Polyangæus</i>	1	0	0
<i>Billacomorpha</i>	0	0	1	<i>Rhaphidolabis</i>	2	1	2
<i>Billacomorphella</i>	0	0	1	<i>Dicranota</i>	1	4	0
<i>Trichocera</i> *.....	0	3	2	<i>Molophilus</i>	1	3	3
<i>Dicranomyia</i>	9	11	13	<i>Erioptera</i> , s. l.....	9	7	11
<i>Rhipidia</i>	2	1	2	<i>Cheilotrichia</i>	1	0	0
<i>Geranomyia</i>	1	0	2	<i>Psiloconopa</i> *.....	0	2	0
<i>Discobola</i>	3	1	1	<i>Helobia</i>	1	1	1
<i>Limonia</i>	13	3	8	<i>Cryptolabis</i>	0	0	1
<i>Libnotes</i>	2	0	0	<i>Gnophomyia</i>	1	0	1
<i>Helius</i>	1	1	1	<i>Gonomyia</i> , s. l.....	4	0	2
<i>Elliptera</i>	1	0	0	<i>Rhabdomastix</i> *.....	0	1	0
<i>Dicranoptycha</i>	1	0	0	<i>Paratropesa</i>	1	0	0
<i>Antocha</i>	6	0	1	<i>Teucholabis</i>	1	0	0
<i>Orimarga</i>	0	1	0	<i>Toxorhina</i>	0	0	1
<i>Ula</i>	2	1	1	<i>Neolimnophila</i>	1	0	1
<i>Epiphragma</i>	1	0	1	<i>Cladura</i> *.....	0	0	1
<i>Dactylolabis</i> *.....	0	0	1	<i>Chionea</i>	1	2	0
<i>Limnophila</i> , s. l.....	7	8	12	<i>Cylindrotoma</i>	1	1	1
<i>Pseudolimnophila</i> *.....	0	0	4	<i>Liogma</i>	0	0	1
<i>Idioptera</i>	0	3	1	<i>Phalacrocera</i> *.....	0	1	1
<i>Phyllolabis</i>	0	1	0	<i>Dolichopeza</i>	0	1	1
<i>Ulomorpha</i>	0	0	1	<i>Oropeza</i>	1	0	4
<i>Pilaria</i>	1	0	5	<i>Nesopeza</i>	1	0	0
<i>Hexatoma</i> *.....	0	1	0	<i>Ctenophora</i>	1	0	1
<i>Eriocera</i>	2	0	2	<i>Tanyptera</i>	1	2	1
<i>Elephantomyia</i>	1	0	1	<i>Dictenidia</i> *.....	0	1	0
<i>Adelphomyia</i>	0	0	3	<i>Pselliophora</i>	1	0	0
<i>Pedicia</i>	1	2	1	<i>Prionocera</i>	0	4	1
<i>Tricyphona</i> *.....	0	1	5	<i>Nephroloma</i>	8	1	10
<i>Rhaphidolabina</i>	1	0	1	<i>Tipula</i>	18	29	30

The most surprising features of the crane-fly fauna of the region under consideration will be noted from a study of Table 2. These are the great abundance of species of the

genera *Limonia* and *Antocha*; the lack of genera such as *Tricyphona* and *Phalacrocer*; the occurrence of a species of the genus *Paratropesa*, otherwise known only from tropical America.

PUBLISHED REFERENCES TO THE TIPULID FAUNA OF SAGHALIEN AND
HOKKAIDO

The crane-fly fauna of Saghalien has been virtually unknown. The only collections that have been made in the past seem to be those discussed by Matsumura (1911), a small collection taken by Paul Labbé in 1902 and now preserved in the Paris Museum, and a few specimens taken by Satoru Kuwamura in 1921 and kindly sent by him to me. The latter records have been included in the present paper.

Matsumura's paper (1911) cited above is the first and only published account of this interesting fauna. In that paper he records the following species:

Xiphura macra Loew from Solowiyofka; this probably equals the *Tanyptera jozana* (Matsumura) var. of the present paper, and is certainly not *T. gracilis* (Portschinsky), the prior name of *Xiphura macra*.

Tipula paludosa Meigen, recorded doubtfully, but the occurrence of this species in eastern Asia would not be surprising.

Tipula variicornis Schummel, recorded from Tonnaitcha (as *Pachyrhina annulicornis* Meigen).

In addition to these, Matsumura describes as new the following:

Limnobia sachalinensis sp. nov. This certainly is not a *Limonia*, but very possibly a *Limnophila* (vein M_{1+2} forked).

Metalimnobia vittata gen. et sp. nov. The identity of this is uncertain, but it is possibly a *Limonia*, because of the toothed unguis.

Neither of the above species was taken by Doctor Esaki.

The crane flies of Hokkaido are rather better known than are those of Saghalien, though still insufficiently when compared with the extensive and fairly complete list from Honshiu. All of the species hitherto recorded from Hokkaido are included in papers by Matsumura and by me which are included in the bibliography at the end of this paper. All of the species of Tipulidæ from Japan, described by Coquillett, Edwards, Enderlein, Loew, Westwood, and others seem to have been taken in the main island of the Empire.

PTYCHOPTERIDÆ

Genus *PTYCHOPTERA* Meigen

Ptychoptera MEIGEN, Illiger's Mag. 2 (1803) 262.

The only species of *Ptychoptera* taken on the present expedition was *P. subscutellaris* Alexander, hitherto known only from Hokkaido.

Ptychoptera subscutellaris Alexander.

Ptychoptera subscutellaris ALEXANDER, Insec. Inscit. Menst. 9 (1921) 81-83.

Saghalien: Konuma, July 17, 1922 (*Esaki*); Toyohara, July 24, 1922 (*Esaki*).

The femora and tibiæ are more conspicuously blackened apically than in the types from the vicinity of Sapporo.

TIPULIDÆ

TRIBE LIMNOBIINI

Genus *DISCOBOLA* Osten Sacken

Discobola OSTEN SACKEN, Proc. Ent. Soc. Phila. (1865) 226.

The genus *Discobola* includes thirteen described species, eight of which are known only from New Zealand. The occurrence of undescribed species of this genus in Japan has been known to me for many years. In the present collection, no fewer than three species were included, two of which are considered as being undescribed, while the third cannot be distinguished from the *Discobola argus* (Say) of eastern North America. The Holarctic species of *Discobola* may be separated as follows:

Key to the Holarctic species of the genus Discobola.

1. The spot on costal margin of wing surrounding tip of vein Sc solid.... 2.
The spot on costal margin of wing surrounding tip of vein Sc not solid,
there being small hyaline dots in the outer ends of cells C and Sc.... 3.
2. Cell M without small brown clouds; mesal face of ventral dististyle
of male hypopygium produced mesad into a beak. (Western Palæarctic
Region.)..... *D. annulata* (Linn.).
- Cell M with brown clouds and marblings; mesal face of ventral disti-
style of male hypopygium not produced into a beak. (Western Pa-
læarctic Region.)..... *D. caesarea* (O. S.).
3. Antennæ with the second segment light yellow; halteres black, the bases
of stem and knob light yellow; femora yellow with a very narrow,
brown, subterminal ring, the pale apex beyond it much broader; wings
with a concentric ocellate pattern, the rings being double. (Eastern
Palæarctic Region.)..... *D. margarita* sp. nov.

- Antennal scape uniformly black; bases of knobs of halteres black; femora yellow with a black subterminal ring that is much more extensive than the yellow apex; wings with an ocellate pattern, the rings single..... 4.
4. Mesonotal prescutum without distinct stripes, brown with a sparse yellowish pollen; halteres yellow, only base of knob black. (Eastern Palæarctic Region.)..... *D. moiwana* sp. nov.
- Mesonotal prescutum distinctly striped with black; halteres with the stem black..... 5.
5. Thoracic pleura conspicuously silvery pruinose; antennal flagellum paler than scape. (Western Nearctic Region.)..... *D. elegans* (Doane).
- Thoracic pleura inconspicuously silvery; antennæ black throughout (Nearctic Region and eastern Palæarctic Region.)..... *D. argus* (Say).

Discobola margarita sp. nov.

General coloration yellow; antennæ black, the second segment conspicuously light yellow; a narrow brown longitudinal stripe on lateral margins of pronotum and prescutum and another on dorsal pleurites; halteres black, base of stem and knob light yellow; femora with a very narrow, brown, subterminal ring; wings with an ocellate pattern, the outer rings of which are double, each having a pale center; abdominal segments brownish yellow, the caudal margins very narrowly brown.

Male, length, 7 to 8 millimeters; wing, 7.2 to 8.2. Female, length, 8 millimeters; wing, 8.5.

Rostrum and palpi black. Antennæ black, the second scapal segment abruptly light yellow. Head black, grayish pruinose. Pronotum shiny yellow, sides dark brown. Mesonotal prescutum and scutum yellow, the lateral margins of the former conspicuously dark brown; scutellum and postnotum obscure yellow, the latter with the posterior margin infuscated. Pleura brownish yellow, with a conspicuous dark brown longitudinal stripe extending from behind fore coxæ onto the pleurotergites of postnotum; sternopleura ventrad of this area covered with an appressed silvery pubescence; the dark longitudinal stripes of dorsum and pleuron described above are separated from one another by the pale dorsopleural membrane. Halteres black, base of stem and bases of knobs conspicuously light yellow, remainder of knobs brownish black. Legs with coxæ and trochanters obscure yellow; femora concolorous with a very narrow and indistinct brown subterminal ring some distance before tips; in some specimens, this ring is almost obliterated; tibiæ and tarsi yellow, the terminal tarsal segments dark brown. Wings yellow with a very heavy ocellate pattern, arranged about as in *Discobola argus*; the centers of the ocellate markings are

solid but the rings are double, each having a pale center with narrow dark margins; the general effect of this type of marking is a very abundant, delicate brown marking. Venation: Cell 1st M_2 elongate, tending to be irregular in outline, m being much shorter than the outer deflection of M_3 , the latter angulate just beyond midlength. In the female, the cell is more regularly rectangular in outline. Abdomen brownish yellow, the caudal margins of the segments narrowly but conspicuously dark brown.

Habitat.—Japan (Saghalien and Hokkaido).

Holotype, male, Kamiotoineppu, Hokkaido, August 24, 1922 (T. Esaki).

Allotype, female, Kusunnai, Saghalien, August 2, 1922 (T. Esaki).

Paratopotypes, 2 males; paratype, male, Jozankei, Hokkaido, August 19, 1922 (T. Esaki).

This exquisite fly is one of the most distinct species of the genus so far discovered. It is named in honor of my wife, Mabel M. Alexander.

Discobola moiwana sp. nov.

Female, length, about 9 millimeters; wing, 9.5.

Generally similar to *Discobola argus* (Say), from which it differs as follows:

Mesonotal prescutum without distinct stripes, rather uniformly dark brown with a sparse yellowish pollen. Longitudinal brown pleural stripe very narrow, the silvery pleural areas correspondingly extensive. Halteres yellow, only bases of knobs black. Yellow femoral tips narrower. Wings with cell M marbled with brown; supernumerary cross vein in cell 1st A longer than vein 2d A beyond it.

Habitat.—Japan (Hokkaido).

Holotype, female, Mount Moiwa, September 17, 1922 (T. Esaki).

Discobola argus (Say).

Limnobia argus SAY, Long's Exped., Append. (1824) 358.

One female, Akan, Hokkaido, September 4, 1922 (T. Esaki).

I have compared this specimen critically with an extensive series of Nearctic *Discobola argus*, and can find no differences that can be considered as being of even subspecific value. It is possible that the male sex will show such differences, but this sex is not available at the present time. This is the first record of a Nearctic crane fly occurring in Japan that does not also occur in Europe.

All three species of *Discobola* recorded in this paper as from Japan are very different from the two European forms.

Genus GERANOMYIA Haliday

Geranomyia HALIDAY, Ent. Mag. 1 (1833) 154.

Geranomyia avocetta Alexander.

Geranomyia avocetta ALEXANDER, Can. Ent. 45 (1913) 205, 206.

One small female, Toyohara, Saghalien, July 13, 1922 (*T. Esaki*).

Genus RHIPIDIA Meigen

Rhipidia MEIGEN, Syst. Besch. 1 (1818) 153.

Rhipidia maculata Meigen.

Rhipidia maculata MEIGEN, Syst. Besch. 1 (1818) 153, pl. 5, fig. 11.

This species has a very extensive range throughout the North Temperate regions of the world. The following records are available from the present collection:

Saghalien: Toyohara, July 13 to 23, 1922 (*T. Esaki*); Tachinosawa, July 26, 1922 (*T. Esaki*); Odomari, August 9, 1922 (*T. Esaki*). Hokkaido: Jozankei, August 19, 1922 (*T. Esaki*); Kamukotan, August 22, 1922 (*T. Esaki*); Kamiotoineppu, August 23 and 24, 1922 (*T. Esaki*).

The number of spines on the rostrum of the dististyle of the male hypopygium runs as high as seven.

Rhipidia pulchra septentrionis Alexander.

Rhipidia pulchra septentrionis ALEXANDER, Can. Ent. 45 (1913) 206, 207, pl. 3, fig. 1.

As indicated in other papers, this species runs very close to *Dicranomyia* and may more properly be considered as belonging to that genus. The following records are available from the present collection, all the specimens having been taken by Doctor Esaki:

Saghalien: Toyohara, July 20, 1922. Hokkaido: Jozankei, August 19, 1922; Kamukotan, August 22 and 23, 1922; Kamiotoineppu, August 25, 1922; Shikaripetsu, August 26, 1922; Kamio-koppe, August 27, 1922; Akkeshi, September 11, 1922.

Genus DICRANOMYIA Stephens

Dicranomyia STEPHENS, Cat. Brit. Ins. 2 (1829) 243.

This very extensive genus was well represented in number of species.

Dicranomyia mesosternata Alexander.

Dicranomyia mesosternata ALEXANDER, Ann. Ent. Soc. Am. 12 (1919) 329, 330.

Doctor Esaki collected the following material: Saghalien: Toyohara, July 20 to 23, 1922, including one female at honey bait trap. A male from this material has cell 1st M_2 open by the atrophy of m in both wings. Hokkaido: Sapporo, August 17 to 19 and September 7, 1922; Abashiri, August 31, 1922; Akan, September 3 to 7, 1922; Panketo, September 6, 1922.

Dicranomyia longipennis (Schummel).

Limnobia longipennis SCHUMMEL, Beitr. zur Ent. 1 (1829) 104, pl. 1, fig. 2.

This species is distributed throughout the Holarctic Region. The author had already recorded it from Honshiu.² The following material from Hokkaido was included in the present collection:

Sapporo, August 18, 1922 (*T. Esaki*); Kamiotoineppu, August 23, 1922 (*T. Esaki*).

In the right wing of the Sapporo specimen, cell 1st M_2 is closed by the retention of m; the left wing is normal.

Dicranomyia immodestoides Alexander.

Dicranomyia immodestoides ALEXANDER, Ann. Ent. Soc. Am. 12 (1919) 327, 328.

This species has a wide range in Honshiu. It is included from Saghalien and Hokkaido as a result of the following specimens collected by Doctor Esaki:

Saghalien: Toyohara, July 13 to 25, 1922; Maoka, July 28, 1922; Kusunnai, August 2, 1922. Hokkaido: Sapporo, August 17, September 13 to 26, 1922; Jozankei, August 19, 20, 1922; Kamuikotan, August 22, 1922; Kamiotoineppu, August 23, 24, 1922; Shikotsu, September 24, 1922; Tomakomai, September 25, 1922; Onuma, September 27, 1922.

Dicranomyia subtristis sp. nov.

Related to *D. tristis* (Schummel) of the Western Palaearctic Region. General coloration gray, the prescutum with a broad, brown, median stripe; male hypopygium with spines of rostrum elongate, arising from long, enlarged bases that are connate basally.

²Trans. Am. Ent. Soc. 46 (1920) 1.

Male, length, 5.6 millimeters; wing, 7.4. Female, length, 5.5 millimeters; wing, 7.

Rostrum and palpi black. Antennæ black throughout. Head light gray, vertex between eyes relatively narrow. Mesonotal prescutum gray with a broad, medium dark brown stripe, the anterior end of which is indistinctly bifid; lateral stripes very small to nearly obsolete; remainder of mesonotum gray, the scutal lobes dark brown. Pleura dark gray. Halteres yellow, knobs infuscated. Legs with coxæ dark gray; trochanters obscure yellow; remainder of legs dark brown, basal half of each femur obscure yellow. Wings faintly tinged with gray; stigma small, brown, surrounding r; veins brown, those in the costal region somewhat paler. Venation: Sc_1 ending opposite or immediately before origin of Rs, Sc_2 close to its tip; Rs gently arcuated, about one-half longer than the basal deflection of R_{4+5} ; cell 1st M_2 about as long as vein M_3 beyond it; basal deflection of Cu_1 a short distance before fork of M. Abdomen dark brown, the genital segment paler. Male hypopygium (Plate 1, fig. 1) with basistyles short and stout, the caudal lateral angle produced into a blunt point; dorsal face of basistyle with a small setiferous lobe; mesal face of basistyle produced caudad into a long, relatively stout lobe; ventral dististyle yellow, the mesal face produced mesad into a slender rostrum that bears far out toward its apex two elongate spines whose bases are enlarged and united for about one-half their length; dorsal dististyle suddenly narrowed into an acute spine at tip as in the *tristis* group of species.

In *tristis*, the basistyle has the lobes slenderer; the spines of the rostrum of the ventral dististyle from short, separate bases, the apex beyond them long-produced; a linear row of about five long setæ near the base of the rostrum.

Habitat.—Japan (Hokkaido).

Holotype, male, Kamuikotan, August 22, 1922 (*T. Esaki*).

Allotopotype, female.

American species of the *tristis* group include *D. liberta* Osten Sacken, *D. libertoides* Alexander, and *D. knabi* Alexander.

Dicranomyia sachalina sp. nov.

General coloration gray; rostrum and palpi brownish black; antennæ black; prescutum with an ill-defined stripe; wings very faintly darkened; stigma oval, pale brown; Sc short, cell 1st M_2 closed; hypopygium with rostrum of the ventral disti-

style short, bispinous; dorsal dististyle short and strongly curved.

Male, length, about 6 millimeters; wing, 6.5. Female, length, 7 to 7.5 millimeters; wing, 7 to 8.

Rostrum and palpi brownish black. Antennæ black throughout. Head dark gray. Pronotum and mesonotum dark, covered with an abundant gray pruinosity, prescutum with an ill-defined median stripe on the anterior portion; pruinosity on scutellum and postnotum lighter gray. Pleura light gray pruinose. Halteres pale, knobs dark brown. Legs with coxæ and trochanters obscure yellow; femora obscure yellow, passing into brown before tips; remainder of legs dark brown. Wings very faintly tinged with darker; stigma oval, pale brown; veins pale brown, those at wing base paler. Venation: Sc short, Sc₁ ending just beyond origin of Rs, Sc₂ some distance from tip of Sc₁, the latter alone about equal to the basal deflection of M₁₊₂; Rs arcuated, about twice the length of R₂₊₃; cell 1st M₂ closed; basal deflection of Cu₁ at fork of M. Abdomen dark brown, the genital segment paler. Male hypopygium with basistyles relatively short, the mesal face produced into stout lobes that are very densely set with microscopic setæ and setulæ, apex slender and provided with a few conspicuous setiferous tubercles. Ventral dististyle fleshy, the mesal face produced into a relatively short beak that bears two subequal spines, these not widely separated; dorsal dististyle a short, powerful, strongly curved hook. Ninth tergite with a broad, rectangular, median notch. Ovipositor with the valves relatively stout.

Habitat.—Japan (Saghalien).

Holotype, male, Sakaehama, July 20, 1922 (*T. Esaki*).

Allotype, female, Toyohara, July 19, 1922 (*T. Esaki*).

Paratopotype, 1 female; paratypes, 3 females, with the allotype, July 15 to 20, 1922; 1 female, Odasam, August 6, 1922 (*T. Esaki*).

Dicranomyia sachalina bears a superficial resemblance to *D. subtristis*, but is a very different fly. The stigma is full though pale, in *D. subtristis* being a narrow seam to r.

Dicranomyia sparsa sp. nov.

General coloration yellowish brown, prescutum with three slightly darker stripes; legs yellow, tips of femora and tibiæ faintly darkened; wings strongly tinged with yellow, stigma bicolorous; veins pale, cord and outer end of cell 1st M₂ dark brown; Sc₁ longer than Rs.

Female, length, 7.5 millimeters; wing, 7.6.

Rostrum short, pale brownish testaceous, mouth parts greenish, palpi pale brown. Antennæ brown, the flagellar segments oval. Head brownish gray. Mesonotal prescutum yellowish brown with three darker stripes, the median stripe more brownish, the lateral stripes more grayish; scutum with the narrow central portion gray, lobes brown, margined mesially by yellow; scutellum yellow, with a narrow, gray, median area; postnotum brownish testaceous. Pleura pale brown, very indistinctly variegated with gray. Halteres very short, with large knobs, pale, knobs a little darker. Legs with coxæ and trochanters pale testaceous, femora, tibiæ, and basitarsi yellow, tips very indistinctly darkened; terminal tarsal segments brown. Wings strongly tinged with yellow, base and costal region more saturated; stigma pale brown, the narrow part surrounding r darker brown, producing a bicolourous stigmal area; veins pale, cord and outer end of cell 1st M_2 conspicuously dark brown to produce the appearance of a faintly darkened wing. Venation: Sc short, Sc_1 ending a short distance beyond origin of Rs; Sc_2 far from tip of Sc_1 so the latter vein alone is longer than Rs; Rs nearly straight, with several macrotrichiæ; cell 1st M_2 closed, longer than the veins issuing from it; basal deflection of Cu_1 close to fork of M. Abdominal tergites dark brown, the caudal margin of basal segments indistinctly pale; basal sternites yellowish. Ovipositor with the tergal valves slender.

Habitat.—Japan (Saghalien).

Holotype, female, Toyohara, July 23, 1922, at honey bait trap (T. Esaki).

Dicranomyia spinicauda sp. nov.

General coloration yellowish brown; rostrum orange; mesonotal prescutum with three brown stripes; wings faintly tinged with brownish yellow; Sc short, Sc_1 long; cell 1st M_2 closed; male hypopygium with the two spines of rostrum widely separated; mesal face of ventral dististyle beyond rostrum densely set with spinous setæ.

Male, length, 5.5 millimeters; wing, 6.5 to 7. Female, length, 6.5 to 6.8 millimeters; wing, 7.2 to 7.5.

Rostrum orange, the palpi conspicuous, dark brown. Antennæ with first scapal segment orange; remainder of antennæ dark brown. Head gray. Pronotum dark brown, the lateral margins paler. Mesonotal prescutum yellowish brown, with a broad, conspicuous median and less distinct lateral stripes;

scutum yellow, the lobes dark brown; scutellum dark brown, broadly yellow medially; postnotum dark brown medially, the pleurotergite pale. Pleura pale, sparsely pollinose, the sternopleura darkened. Halteres dark brown, the base of stem narrowly pale. Legs with the coxæ and trochanters yellow; femora brownish yellow indistinctly darker toward tips; tibiæ and tarsi passing into dark brown. Wings faintly tinged with brownish yellow, base and costal region a little brighter; veins brown. Venation: Sc short, Sc₁ ending before origin of Rs; Sc₂ some distance before tip of Sc₁, the latter alone a little longer than the basal deflection of R₄₊₅; cell 1st M₂ closed; basal deflection of Cu₁ at fork of M. Abdomen dark brown, the basal sternites paler; hypopygium obscure brownish yellow. Male hypopygium (Plate 1, fig. 5) with basistyles relatively slender, the mesal face produced mesad into a very broad, triangular lobe; ventral dististyle fleshy, the mesal face at base produced into a slender rostrum that bears two very widely separated spines, the outer one shortly before tip, the shorter inner spine before midlength of rostrum; mesal face of ventral dististyle caudad of rostrum densely set with abundant spinous setæ; dorsal dististyle slender, strongly curved to the acute tip. Gonapophyses bifid by a very deep U-shaped notch, the mesal lobe thus formed slender.

Habitat.—Japan (Saghalien and Hokkaido).

Holotype, male, Toyohara, Saghalien, July 15, 1922 (*T. Esaki*).

Allotopotype, female, July 14, 1922 (*T. Esaki*).

Paratopotypes, 3 males, 1 female, July 17 to 25, 1922; paratype, 1 male, Otanoshike, Hokkaido, September 12, 1922 (*T. Esaki*).

Dicranomyia megacauda sp. nov.

Related to *D. magnicauda* Lundström (Northern Europe), differing chiefly in the details of structure of the male hypopygium; prescutum with a single dark stripe.

Male, length, 5.5 millimeters; wing, 6.8. Female, length, 6.5 millimeters; wing, 7.5.

Rostrum pale orange, the palpi dark brown. Antennæ dark brown throughout. Head dark gray, the anterior part of vertex pale gray. Pronotum dark brown, paler laterally. Mesonotal prescutum pale reddish brown with a single median dark brown stripe that becomes obliterated before suture; remainder of mesonotum pale reddish brown, indistinctly pollinose. Pleura ochereous, very indistinctly striped longitudinally with darker. Halteres elongate, pale yellow, knobs dark brown. Legs with

coxæ and trochanters pale testaceous; femora pale brown, tibiæ and tarsi gradually passing into dark brown. Wings subhyaline, stigma pale brown; veins darker brown. Venation: Sc_1 ending immediately beyond origin of R_s , Sc_2 some distance from tip of Sc_1 the latter vein alone about equal to basal deflection of Cu_1 ; R_s long, nearly straight, in alignment with R_{2+3} basal deflection of R_{4+5} nearly one-half R_s ; basal deflection of Cu_1 close to fork of M ; both wings of type with malformed venation, in the presence of adventitious cross veins between R_{4+5} and M_{1+2} . Abdomen dark brown, sternites yellow. Male hypopygium very large and complicated in structure, generally similar in fundamentals to *D. magnicauda* Lundström; rostriform appendage arising as a conspicuous arm from base of ventral dististyle, shaped as in figure (Plate 1, fig. 2); dorsal dististyle almost straight, apex suddenly narrowed into a stout spine. From the ventromesal face of each basistyle arises the complex structure shown in Plate 1, fig. 3. Female generally similar to male but general coloration of body more ochereous; halteres somewhat shorter; Sc not attaining base of the shorter and more arcuated R_s ; ovipositor with the valves comparatively short but slender.

Habitat.—Japan (Saghalien.)

Holotype, male, Toyohara, July 20, 1922 (*T. Esaki*).

Allotopotype, female.

Dicranomyia globulithorax sp. nov.

Related to *D. globithorax* Osten Sacken; mesonotum less gibbous; wings strongly tinged with blackish; male hypopygium with a single dististyle, the mesal face of which is truncated and densely set with numerous spinous setæ.

Male, length, 5.5 millimeters; wing, 5.8 to 6.

Rostrum and palpi very short, black. Antennæ black throughout, the basal flagellar segments nearly globular, the terminal segments passing through oval to elongate. Head dark brown. Mesonotum dark brown, slightly less gibbous than in *D. globithorax* O. S. Halteres dark brown, base of stem narrowly pale. Legs with coxæ and trochanters obscure testaceous; remainder of legs brownish black. Wings strongly tinged with blackish; stigma indistinct; veins dark brown. Venation: Sc long, ending beyond midlength of the long, straight sector, Sc_2 at tip of Sc_1 ; a supernumerary cross vein in cell Sc_1 , as in *D. globithorax*, this from once to twice its length before r ; tip of R_1 beyond r atrophied; cell 1st M_2 closed; basal deflection of Cu_1 close to or

beyond fork of M, longer than Cu₁. Abdomen dark brown, the basal sternites paler. Male hypopygium (Plate 1, fig. 4) with basistyle produced into a slender, fleshy lobe on mesal face; a single dististyle, this fleshy, the mesal face broadly truncated and densely set with abundant, stout, black spinous setæ.

Habitat.—Japan (Hokkaido).

Holotype, male, Shikotsu, September 27, 1922 (*T. Esaki*).

Paratopotype, male.

Genus LIMONIA Meigen

Limonia MEIGEN, Illiger's Mag. 2 (1803) 262.

Limnobia MEIGEN, Syst. Besch. 1 (1818) 116.

The name *Limonia* must be used in place of *Limnobia* Meigen, it having unquestioned priority. The genus is very rich in species throughout the Japanese Empire, more than a dozen species being included in the present collection. As has been indicated by the author and other writers in other papers, the smaller species of *Limonia* run very close to those of *Dicranomyia* on the one hand, and to those of *Geranomyia* and *Rhipidia* on the other. Strict generic criteria, if such exist, are desiderata.

Limonia quadrinotata (Meigen).

Limnobia quadrinotata MEIGEN, Syst. Besch. 1 (1818) 144.

The following records are available in Esaki's material: Hokkaido: Abashiri, August 30, 1922; Akan, September 3, 1922.

I cannot detect any differences between the Japanese specimens and a series from various countries of central and northern Europe. The specimens vary greatly in size, the wings of the females ranging in length from 9.5 to 13 millimeters. The species is related to *L. solitaria* (Osten Sacken), *L. hudsonica* (Osten Sacken), and *L. fallax* (Johnson), all from eastern North America.

Limonia annulus truncata subsp. nov.

Very similar in general appearance to typical *annulus* (Meigen) of Europe. Gonapophyses of the male hypopygium relatively slender, dilated into a distinct head at apex, this head squarely truncated, densely provided with abundant setæ which are grouped especially at the mesal apical angle. In typical *annulus* the stem of each apophyse is broader, scarcely dilated into a head, apex obliquely truncated, the mesal apical angle

with a dense brush of setæ which continue basad for some distance along the mesal face of apophyse.

Habitat.—Japan (Hokkaido).

Holotype, male, Shikotsu, September 24, 1922 (*T. Esaki*).

Allotype, female, Kamiotoineppu, August 23, 1922 (*T. Esaki*).

Paratypes, female, Kamuikotan, August 22, 1922 (*T. Esaki*); male and female, Abashiri, August 30, 1922 (*T. Esaki*); male, Akan, September 3 to 7, 1922 (*T. Esaki*); 1 female, Panketo, September 6, 1922 (*T. Esaki*); male, Teppetsu, September 9, 1922 (*T. Esaki*).

Limonia bifasciata avis (Alexander).

Limnobia avis ALEXANDER, Ann. Ent. Soc. Am. 11 (1918) 444.

The type is from Takuhara, Shinano Province, Honshiu. The race is distinguished from typical *bifasciata* (Schränk) of Europe, chiefly by the considerable increase in the amount of black on the prescutum, and especially on the tips of the femora. In this subspecies, the vertex bears a large black area extending from the posterior angles of the eyes caudad, narrowed to the occiput. The median prescutal stripe is broad and distinct, split medially, but connected narrowly at the anterior end and more broadly just before the suture. The black femoral tips measure more than 1 millimeter in extent. The Formosan *Limonia xanthopteroides* (Riedel) is probably another geographical race of this widespread Palearctic species.

Hokkaido: Kamiotoineppu, August 25, 1922 (*T. Esaki*); Abashiri, August 30, 1922 (*T. Esaki*); Mount Meakan, altitude 5,300 feet, September 8, 1922 (*T. Esaki*).

Limonia neoindigena sp. nov.

General coloration reddish brown, prescutum with three conspicuous stripes and the extreme lateral margin blackened; anterior pleurites blackened, this also including the fore coxæ; femora pale brown with a black subterminal ring and relatively broad yellow tips; wings yellow, sparsely variegated with brown; r far from tip of R_1 .

Male, length, about 11 millimeters; wing, 12.1. Female, length, about 10 millimeters; wing, 10.8 to 11.

Rostrum, palpi, and antennæ black. Head black, very sparsely pruinose. Pronotum black, broadly yellow laterally; in female, pronotum entirely black. Mesonotal prescutum reddish yellow with three conspicuous black stripes, the median stripe

not reaching suture, the lateral stripes crossing suture and suffusing the anterolateral portions of the scutal lobes; a large brownish black spot on lateral margins of prescutum opposite anterior ends of prescutal stripes; scutum obscure reddish yellow, centers of each lobe dark brown; scutellum dark brown, indistinctly bisected medially by a capillary pale vitta; mediotergite of postnotum broadly brownish black medially, narrowly pale on lateral margins. Pleura with the anterior sclerites largely shiny black, becoming paler, more brownish, on mesepimeron and pleurotergite of postnotum. Halteres brown, knobs and base of stem yellow in male, knobs infuscated in female. Legs with coxæ yellow, fore coxæ shiny black, except for the extreme apex; trochanters yellow; femora pale brown, tips rather broadly yellow, and with a subequal black subterminal ring; tibiæ and tarsi dark brown, the former paler basally. Wings strongly tinged with yellow, base and costal region brighter; rather sparse brown seams distributed as follows: Origin of Rs; along cord and outer end of cell 1st M_2 , and along vein Cu; narrower brown seams along the remaining longitudinal veins and surrounding wing margin, more conspicuous at wing apex; stigma pale brown; veins brown, Sc and prearcular veins brighter. Venation: Sc_2 longer than Sc_1 , ending just beyond midlength of Rs, the latter arcuated at origin; r far from tip of R_1 ; basal deflection of Cu_1 at or before fork of M. Abdomen obscure yellowish brown, sternites brighter, the subterminal segments infuscated. Male hypopygium infuscated; basistyles relatively slender, the mesal face produced into a simple setiferous lobe; a single dististyle, this broad at base, narrowed to apex which bears numerous tiny setæ; dististyle brown except the yellow apical third. Gonapophyses appearing as flattened plates, each with a deep U-shaped notch, the mesal lobe very large. Ædeagus bifid at apex, the ventral face densely set with abundant stout spinulæ.

Habitat.—Japan (Hokkaido).

Holotype, male, Panketo, September 6, 1922 (*T. Esaki*).

Allotype, female, Shikaripetsu, August 25, 1922 (*T. Esaki*).

Paratype, female, Kamiotoineppu, August 25, 1922 (*T. Esaki*).

Limonia karafutonis sp. nov.

Related to *L. tripunctata* (Fabricius); antennæ black, only the basal flagellar segments feebly bicolorous; mesonotal prescutum with a single very broad median stripe; femora yellow,

tips broadly blackened, wings tinged with yellow, sparsely variegated with brown; r remote from tip of R_1 .

Male, length, 7 millimeters; wing, 8.5 to 9. Female, length, about 8 millimeters; wing, 9.

Rostrum and palpi black, mouth parts a little paler. Antennæ black, the two basal flagellar segments bicolorous, the basal half or less of each obscure yellow. Head grayish black, occiput obscure yellow. Pronotum dark brown, paler laterally. Mesonotal prescutum obscure yellow, with a very broad median black stripe, the lateral margins of sclerite narrowly infuscated to produce small lateral stripes; scutum yellow, lobes conspicuously blackened; scutellum and postnotum less distinctly infuscated. Pleura yellow with a faint brown cloud behind fore coxæ. Halteres obscure yellow, knobs faintly infuscated. Legs with coxæ yellow, fore coxæ infuscated; trochanters obscure yellow; femora yellow, tips broadly blackened; tibiæ brownish yellow, tips narrowly blackened; tarsi dark brown, basitarsi paler at proximal ends. Wings tinged with yellow, base and costal region brighter; sparse brown seams distributed as follows: At origin of R_s , Sc_2 , along cord and outer end of cell 1st M_2 ; more conspicuous clouds at r; behind vein Cu, interrupted before its fork; faint brown clouds in the prearcular region and along vein 2d A; veins dark brown, Sc yellow. Venation; Sc_2 a little longer than Sc_1 , ending just before fork of R_s ; r from three to four times its length from tip of R_1 ; basal deflection of Cu_1 at or close to fork of M. Abdominal tergites dark brown, sclerites a little darker posteriorly; basal sternites obscure yellow; hypopygium yellow.

Habitat.—Japan (Saghalien).

Holotype, male, Toyohara, July 17, 1922 (*T. Esaki*).

Allotopotype female, July 23, 1922 (*T. Esaki*); at honey bait trap.

Paratopotypes, 5 males and females, July 14 to 18, 1922 (*T. Esaki*).

Limonia episema sp. nov.

Related to *L. trivittata* (Schummel); general coloration obscure yellow; basal antennal segments obscure yellow; mesonotal prescutum with three conspicuous brownish black stripes; femora yellow, tips blackened, with one or two pale brown subterminal rings; wings pale yellow, very sparsely variegated with brown; r encircled by a pale brown ring; abdomen brown, the caudal margins of segments obscure yellow.

Female, length, 9 to 11 millimeters; wing, 10 to 12.

Rostrum and palpi dark brown. Antennæ with scape and basal two flagellar segments obscure yellow; intermediate flagellar segments feebly bicolorous, dark brown, base of each obscure yellow; terminal segments uniformly dark brown. Head dark gray. Pronotum black, the lateral margins obscure yellow. Mesonotal prescutum obscure ferruginous with three very conspicuous black stripes, the median stripe not reaching suture, its caudal end feebly bifid; scutal lobes conspicuously infuscated; the remainder of mesonotum obscure ferruginous. Pleura shiny ferruginous, with an ill-defined brown spot on episternum; ventral portions of sternopleura infuscated. Halteres pale brown, knobs infuscated, base of stem yellow. Legs with coxæ reddish, faintly infuscated; trochanters obscure yellow; femora yellow, tips rather broadly blackened; an ill-defined dusky ring near two-thirds the length of segment, preceded by a distinct yellowish subterminal annulus; some individuals show, in addition, a third cloud near midlength of segment; tibiæ pale brown, tips darker; tarsi dark brown. Wings pale yellow, base and costal region brighter; a very sparse brown pattern, distributed as follows: At origin of R_s ; Sc_2 ; and a seam along vein Cu ; cord and outer end of cell 1st M_2 scarcely seamed with darker; stigma an eyelike spot, r being unseamed; veins dark brown, brighter in the yellow areas. Venation: Sc_1 ending just beyond midlength of R_s ; Sc_1 a little longer than Sc_2 ; r about twice its length from tip of R_1 ; basal deflection of Cu_1 variable in position, from before to beyond fork of M . Abdomen brown, the caudal margins of segments obscure yellow; sternites obscure yellow, the caudal margins brighter; basal lateral angles of sternites infuscated.

Habitat.—Japan (Saghalien).

Holotype, female, Toyohara, July 23, 1922 (*T. Esaki*); at honey bait trap.

Paratopotypes, 3 females, July 20 to 23, 1922 (*T. Esaki*).

Limonia plutonis sp. nov.

General coloration black, sparsely pruinose; halteres yellow, the knobs infuscated; legs slender, black, the femoral bases yellow; wings yellow with a sparse brown pattern.

Female, length, 10 millimeters; wing, 14.5.

Rostrum and palpi black. Antennæ with the basal segment black, the second segment brown; flagellum broken. Head dark gray; vertex between eyes reduced to a linear strip, the anterior

end of which is light silvery. Pronotum black, very sparsely dusted with gray. Mesonotum black, the prescutal interspaces sparsely pruinose, stripes shiny black; scutum, scutellum, and postnotum clear gray pruinose. Pleura black, sparsely pruinose. Halteres yellow, knobs infuscated. Legs with coxæ black; trochanters light yellow; remainder of legs black, the femoral bases yellow; legs relatively long and slender. Wings tinged with yellow, base and cells C and Sc bright yellow; a conspicuous brown stigma, extending basad in cell 1st R_1 to opposite fork of R_s ; a small brown cloud at origin of R_s ; conspicuous brown seams along cord and outer end of cell 1st M_2 ; wing tip conspicuously dark brown, broadest in cell R_3 ; a broad and conspicuous brown seam along vein Cu, more extensive in cell M; veins dark brown, yellowish in the flavous areas. Venation: Sc_1 ending just before fork of R_s , Sc_2 some distance from tip, Sc_1 alone about one-half longer than r; r about twice its length from tip of R_1 ; cell 1st M_2 long and narrow, gently widened distally, longer than the veins issuing from it; basal deflection of Cu_1 a short distance beyond fork of M. Abdomen dark brownish black. Valves of ovipositor reddish horn color; valves obliquely truncated at tips, the sternal valves more strongly so.

Habitat.—Japan (Saghalien).

Holotype, female, Toyohara, July 13, 1922 (*T. Esaki*).

Limonia monacantha sp. nov.

General coloration dark brown, wings tinged with brown and with a sparse darker brown pattern; male hypopygium with the ventral dististyle bearing on its mesal face a slender, pale, curved appendage and a single blackened spine.

Male, length, about 4.8 millimeters; wing, 6.3.

Rostrum and palpi very small, black. Antennæ black throughout, the basal flagellar segments subglobular, the terminal segments gradually more elongate; segments very short-pedicellate. Head black. Pronotum black. Mesonotum and pleura dark brown, without distinct stripes. Halteres dark brown. Legs brown throughout. Wings distinctly tinged with brown and with a sparse, darker brown pattern, distributed as follows: A large cloud at origin of R_s ; a small cloud at tip of Sc; a large, circular stigmal blotch; conspicuous brown seams along cord and outer end of cell 1st M_2 ; veins dark brown. Venation: Sc long, ending beyond midlength of R_s , Sc_2 at tip of Sc_1 ; R_s long, angulated and feebly spurred at origin; r about one and one-half times its length from tip of R_1 which is curved strongly into

costa beyond it, inner ends of cells R_3 and 1st M_2 far basad of cell R_5 ; basal deflection of Cu_1 just beyond fork of M . Abdomen dark brown, the basal sternites a little paler. Male hypopygium (Plate 1, fig. 8) with basistyle relatively stout, the mesal face produced into a conspicuous lobe which bears near its apex on the caudal end a small tubercle bearing two or three long, powerful setæ. Ventral dististyle fleshy, the mesal face at base produced mesad into a long, slender, gently curved appendage that is only a little shorter than the dorsal dististyle; the inner or cephalic margin of this bears five or six setiferous tubercles that become more distant from one another toward apex; apex with a stouter seta; at base of this appendage and inserted just beyond it on dististyle itself is a powerful spine, curved at base, the long, straight apex heavily blackened. Dorsal dististyle straight basally, the apical third narrowed and bent almost at a right angle. Gonapophyses appearing as flattened plates, the mesal apical angle produced caudad into a short, gently curved hook.

Habitat.—Japan (Hokkaido).

Holotype, male, Teppetsu, September 9, 1922 (*T. Esaki*).

Limonia basispina sp. nov.

General coloration dark brown, the prescutal stripes pale reddish brown; wings tinged with brown, with a conspicuous dark brown pattern; male hypopygium with the mesal face of the ventral dististyle produced into a conspicuous chitinized lobe that bears a long, straight spine at one-third its length.

Male, length, 6.2 to 7 millimeters; wing, 7.8 to 8.6. Female, length, 5 to 6.2 millimeters; wing, 6.5 to 7.2.

Rostrum and palpi black. Antennæ black throughout, the basal flagellar segments globular, the terminal segments passing through oval to cylindrical, segments with a short basal pedicel. Anterior part of vertex silvery white; remainder of head dark brown. Pronotum pale ochereous brown medially, the lateral margins a little darker. Mesonotal prescutum dark brown with three conspicuous, pale reddish brown stripes; scutum pale medially, lobes reddish brown with the mesal edge dark brown; scutellum and postnotum dark brown, the posterior third of latter more reddish. Pleura dark brown, indistinctly variegated with paler brown. Halteres dark brown, the extreme base of stem obscure yellow. Legs with coxæ ochereous, the extreme bases brown; trochanters yellow; femora pale brownish yellow, faintly darkened to tips; remainder of legs dark brown; claws

simple. Wings with a strong brown tinge and with a conspicuous dark brown pattern, distributed as broad clouds at origin of Rs, tip of Sc, fork of Rs, stigma, cord, outer end of cell 1st M_2 , and, in cases, a spot at tip of R that is distinct from stigmal spot; wing tip distinctly darkened; veins dark brown. Venation: Sc long, Sc_2 at tip of Sc_1 , ending from two-thirds to three-fourths the length of Rs; Rs strongly angulated and spurred at origin; r unusually variable in position, in cases more than twice its length from tip of R_1 , in other examples less than its length from tip; inner end of cell R_3 lying slightly basad of 1st M_2 and far basad of R_5 ; cell 1st M_2 closed; m shorter, usually much shorter, than the more or less arcuate outer deflection of M_3 ; basal deflection of Cu_1 close to fork of M. Abdomen dark brown, the basal segments a little paler. Male hypopygium (Plate 1, fig. 7) with basistyle relatively stout, the mesal face produced into a conspicuous, pale, chitinized lobe that bears at its apex on the caudal end a conspicuous tubercle bearing about six stout setæ. Ventral dististyle fleshy, the mesal face at base produced mesad into a conspicuous, cylindrical arm which bears near one-third its length a powerful, straight spine; the apical two-thirds gently curved, bearing at its tip a group of setæ. Dorsal dististyle gently curved to the acute tip. Gonapophyses appearing as flattened plates, the mesal apical angle produced caudad into a gently curved hook, with a small chitinized tubercle laterad of its base.

Habitat.—Japan (Hokkaido).

Holotype, male, Panketo, September 6, 1922 (*T. Esaki*).

Allotype, female, Kamuikotan, August 22, 1922 (*T. Esaki*).

Paratypes, 1 male, Kamiokoppe, August 27, 1922 (*T. Esaki*); 1 female, Kamiotoineppu, August 23, 1922 (*T. Esaki*).

Limonia subnubeculosa (Alexander).

Limnobia subnubeculosa ALEXANDER, Trans. Am. Ent. Soc. 46 (1920) 5, 6.

Doctor Esaki's material includes the following records:

Saghalien: Toyohara, July 23, 1922, at honey bait trap; Odasam, August 5, 1922.

The species was described from Honshiu and has not yet been discovered in Hokkaido.

Limonia neonebulosa nom. nov.

Dicranomyia nebulosa ALEXANDER, Can. Ent. 45 (1913) 203 to 205, preoccupied by *Limonia nebulosa* (Zetterstedt), Ins. Lapponica, Diptera (1838) 836.

The collection includes the following records, collected by Doctor Esaki:

Saghalien: Toyohara, July 23, 1922, at honey bait trap. Hokkaido: Sapporo, August 17, 1922; Jozankei, August 19, 1922; Kamuikotan, August 22, 1922; Kamiotoineppu, August 23 to 26, 1922; Shikaripetsu, August 26, 1922; Kamiokoppe, August 27, 1922.

The fly had been known hitherto only from stations in Honshiu. It varies considerably in size, males showing wing lengths of from 4.7 to 8 millimeters.

Limonia machidai (Alexander).

Dicranomyia machidai ALEXANDER, Ann. Ent. Soc. Am. 14 (1921) 113.

This little fly was described from specimens taken in the vicinity of Tokyo, Honshiu. It seems to be more correctly referable to *Limonia* than to *Dicranomyia*. Esaki's collection adds the following records:

Saghalien: Toyohara, July 13 to 20, 1922. Hokkaido: Sapporo, August 17, 18, 1922; Kamuikotan, August 22, 1922; Kamiotoineppu, August 23, 24, 1922; Abashiri, August 30, 1922.

Limonia angustistria sp. nov.

General coloration light brownish yellow, the prescutum with a Λ -shaped brown median stripe; pleura obscure yellow with a narrow but very conspicuous dark brown longitudinal stripe; wings subhyaline, stigma darker brown; Rs angulated and spurred at origin; r at tip of R_1 .

Male, length, 4 to 4.8 millimeters; wing, 5.8 to 6.2. Female, length, 4.8 to 5 millimeters; wing, 6.2 to 6.8.

Rostrum and palpi brown. Antennæ black throughout, the flagellar segments subglobular, passing into oval toward end of organ. Head dark brown. Mesonotal prescutum light brownish yellow, the median stripe darker brown, beyond mid-length of sclerite becoming obliterated but at this point becoming confluent with the lateral stripes, thus appearing Λ -shaped, the arms inclosing a pale triangle at suture; lateral margins of segments faintly infuscated; remainder of mesonotum light brownish yellow, the scutal lobes dark brown. Pleura obscure yellow with a narrow but very conspicuous dark brown longitudinal stripe extending from propleura to base of abdomen, passing beneath root of halteres; sternopleura faintly darkened between fore and middle coxæ. Halteres pale brown, the knobs a little darker, base of stem narrowly brightened. Legs

with coxæ and trochanters yellow; femora obscure yellow; tibiæ and tarsi pale brown, the terminal segments of latter darkened. Wings subhyaline, stigma pale brown, circular to oval in outline, veins dark brown. Venation: Sc long, Sc₁ ending from two-thirds to three-fourths the length of Rs, Sc₂ close to its tip; Rs angulated and feebly spurred at origin; r at tip of R₁; inner end of cell R₃ far distad of inner ends of cells R₅ and 1st M₂; m a little shorter than outer deflection of M₃; basal deflection of Cu₁ near fork of M; Cu₂ and basal deflection of Cu₁ subequal. Abdominal tergites dark brown, the caudal margins of segments narrowly yellowish; basal sternites paler but similarly marked; hypopygium and genital segment of female obscure yellow. Male hypopygium (Plate 1, fig. 6) with each basistyle cylindrical, the mesal face with a moderately large setiferous lobe; dististyles two, one fleshy throughout, enlarged basally, narrowed to the slender apex, the mesal or cephalic face with numerous large setæ which become modified into powerful yellow spines on basal half of style to form a comb; the other dististyle is complicated in structure, consisting of two chitinized arms and a bilobed fleshy outer lobe that is provided with long setæ; the longest chitinized lobe produced into a slender beak, on outer margin before tip with a few powerful bristles; second arm a small, ovate blackened scale at base of the larger one. Gonapophyses relatively slender. *Ædeagus* bilobed at apex.

Habitat.—Japan (Hokkaido).

Holotype, male, Kamuikotan, August 22, 1922 (*T. Esaki*).

Allotype, female, Kamiokoppe, August 27, 1922 (*T. Esaki*).

Paratopotypes, 11 males and females; paratypes, 1 male, 1 female, with the allotype; 2 males and females, Jozankei, August 19, 1922 (*T. Esaki*); 2 males, Kamiotoineppu, August 24, 1922 (*T. Esaki*); 1 male, Nayoro, August 26, 1922 (*T. Esaki*).

Limonia angustistria bears a considerable resemblance to *L. machidai* Alexander in size and general coloration but is readily separated by the details of color and the structure of the hypopygium.

Limonia amabilis sp. nov.

General coloration light yellow; head and antennæ black; mesonotal prescutum with a single, narrow, dark brown, median stripe; legs black, the femora with an extensive, obscure yellow ring before tips; wings light yellow with a sparse brown

pattern that includes a large stigma; Rs strongly arcuated; caudal margins of abdominal segments narrowly darkened.

Female, length, 8.5 to 9 millimeters; wing, 7 to 9.

Rostrum and palpi black. Antennæ black, the apex of first and the entire second scapal segment obscure yellow. Head dark brownish black, sparsely pruinose. Pronotum dark brown, narrowly yellowish laterally. Mesonotum light yellow, prescutum with a single narrow dark brown stripe that is narrowed behind and becomes obsolete before suture. Pleura uniformly yellow. Halteres yellow, the knobs dark brown. Legs with coxæ and trochanters yellow; femora brownish black, the extreme tips very narrowly obscure yellow; an extensive obscure yellow annulus before the slightly less extensive black tips; remainder of legs black. Wings light yellow with a sparse brown pattern; stigma large, dark brown; cord and outer end of cell 1st M_2 narrowly seamed with dark brown; a small brown cloud near midlength of cell R, this sometimes barely evident; veins dark brown. Venation: Rs short and very strongly arcuated; Sc_2 at tip of Sc_1 , ending near two-thirds the length of sector; r removed from tip of R_1 to at least two times its length; basal deflection of Cu_1 near fork of M. Abdomen obscure yellow, the caudal margins of segments narrowly darkened. Ovipositor with the valves relatively short and stout, especially the ventral valves.

Habitat.—Japan (Hokkaido).

Holotype, female, Kamiotoineppu, August 25, 1922 (*T. Esaki*).

Paratopotypes, 4 females, August 23 to 25, 1922; 1 female, Kamuikotan, August 22, 1922 (*T. Esaki*); 1 female, Jozankei, August 19, 1922 (*T. Esaki*).

Genus *LIBNOTES* Westwood

Libnotes WESTWOOD, Trans. Ent. Soc. London (1876) 505.

The genus *Libnotes* is a chiefly oriental group which sends two species into Hokkaido.

Libnotes longistigma Alexander.

Libnotes longistigma ALEXANDER, Insec. Inscit. Menst. 9 (1921) 180, 181.

Specimens from Jozankei, August 19, 1922, and Kamiotoineppu, August 23, 24, 1922, were taken by Esaki. The species was described from Koto-sho Islands, near Formosa, and is close to *L. strigivena* (Walker).

Libnotes nohirai Alexander.

Libnotes nohirai ALEXANDER, Ann. Ent. Soc. Am. 11 (1918) 445.

Esaki's material includes specimens from the following localities in Hokkaido:

Akan, September 3, 1922; Panketo, September 6, 1922; Shikotsu, September 24, 1922.

The type locality is Iwate Province, northern Honshiu.

Genus ELLIPTERA Schiner

Elliptera SCHINER, Wien. Ent. Monatschr. 7 (1863) 222.

The genus *Elliptera* includes six described species, two from Europe, three from western North America, and a single small species from eastern North America (southern Illinois to Tennessee). The discovery of an undescribed species in Japan was therefore to be expected.

Elliptera zipanguensis sp. nov.

General coloration brownish black; wings distinctly tinged with brown; r preserved; basal deflection of R_{4+5} only a little longer than r-m; cell 1st M_2 open by the atrophy of the outer deflection of M_3 .

Female, length, 5.8 millimeters; wing, 8.4.

Rostrum and palpi brownish black. Antennæ black throughout, the flagellar segments with a dense white pubescence. Head black, anterior part of vertex sparsely pruinose; vertex between eyes broad, with a compressed median ridge immediately behind antennal bases. Mesonotum shiny brownish black, the lateral margins of prescutum paler. Pleura brownish black with a longitudinal gray stripe across dorsal margin of sternopleura; dorsopleural membrane dark brown. Halteres dark brown, the base of stem narrowly yellowish. Legs with coxæ greenish testaceous, the fore coxæ infuscated basally; trochanters greenish brown; remainder of legs darker brown, the femoral bases paler. Wings distinctly tinged with brown; stigma lacking; veins darker brown. Venation: Sc_1 long, ending a distance before base of deflection of R_{4+5} that is subequal to the length of latter, Sc_2 immediately before origin of long Rs, the latter longer than R_{2+3} alone; the apparent r distinctly preserved, lying beyond fork of Rs a distance about equal to basal deflection of R_{4+5} ; inner ends of cells R_3 , R_5 and 1st M_2 in approximate alignment; deflection of R_{4+5} only about one-third longer than r-m and nearly straight; basal deflection of M_{1+2}

arcuated; cell 2nd M_2 approximately as long as its petiole; basal deflection of Cu_1 beyond fork of M . Abdomen dark brown, the sternites obscure yellow, only the subterminal segments infuscated. Ovipositor with the valves horn-colored, the tergal valves short, very strongly upcurved.

Habitat.—Japan (Hokkaido).

Holotype, female, Shikotsu, September 24, 1922 (*T. Esaki*).

Elliptera zipanguensis is a very distinct species, remarkable in the retention of the *apparent* radial cross vein, which as was indicated by me in earlier papers is, in the Tipulidæ, almost certainly the basal deflection of vein R_2 . The true r is thus presumably lacking in the Diptera, its occurrence in *Dicranota*, *Rhaphidolabina*, and *Polyangæus* being due to a supernumerary cross vein that has persisted in this position in cell R_1 . The present species is further characterized by the very elongate Sc and Rs and the shortened, subtransverse basal deflection of R_{4+5} . The specific name is derived from Zipangu, Marco Polo's designation for the Empire of the Rising Sun.

Genus *HELIUS* St. Fargeau and Serville

Helius ST. FARGEAU and SERVILE, *Encycl. Meth. Ins.* 10, Index (1828) 831.

Rhamphidia MEIGEN, *Syst. Besch.* 6 (1830) 281.

Helius (*Helius*) *tenuirostris* sp. nov.

General coloration shiny yellow, the prescutum with a median dark brown stripe; rostrum long and slender, equal in length to thorax; wings tinged with gray, the costal region yellowish; wing apex infuscated; abdominal tergites yellow, ringed with brown.

Male, length (excluding rostrum), 7 millimeters; wing, 7 to 7.5; rostrum alone, about 1.8 to 2. Female, length, 7.6 to 8 millimeters; wing, 7 to 7.2; rostrum alone, about 1.9.

Rostrum unusually long and slender, about as long as thorax alone, rostrum and palpi black. Antennæ very short, with conspicuous verticils, brown, the second segment obscure yellow. Head brownish gray; vertex between eyes very narrow. Pronotum obscure yellow, infuscated medially. Mesonotal prescutum shiny reddish yellow, the humeral region clearer yellow; a shiny brown median stripe; scutal lobes dark brown, the median area pale; scutellum brownish black; postnotum brown, passing into reddish yellow laterally. Pleura reddish yellow. Halteres pale brownish yellow, brighter at base.

Legs with coxæ and trochanters reddish yellow; femora obscure yellow, the tips narrowly blackened; tibiæ pale brown, tips very narrowly blackened; tarsi black. Wings tinged with gray; cells C and Sc more yellowish; stigma oval, brown; wing tip distinctly infuscated; veins brown, those in costal region yellowish. Venation: Sc_2 ending just before fork of Rs ; r-m shorter than deflection of R_{4+5} ; basal deflection of Cu_1 beyond fork of M, in some cases the distance equal to approximately one-half the deflection. Abdominal tergites obscure yellow, the basal half or more of segments infuscated; sternites uniformly yellow; a subterminal black ring on segments 7 and 8; hypopygium shiny reddish yellow. In the female, the abdominal tergites are dark brown. Ovipositor with the tergal valves very long and slender, straight.

Habitat.—Japan (Hokkaido and Honshiu).

Holotype, male, Mount Minomo, Settsu-no-kuni, Honshiu, June 22, 1922 (*T. Esaki*).

Allotopotype, female.

Paratopotypes, 3 males; paratypes, 1 male, 1 female, Jozankei, Hokkaido, August 19, 1922 (*T. Esaki*).

Genus **DICRANOPTYCHA** Osten Sacken

Dicranoptycha OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila. (1859) 217.

Dicranoptycha venosa sp. nov.

General coloration gray; halteres yellow; legs black, femoral bases yellow, narrowest on forelegs, broadest on posterior femora; wings brownish yellow, base and costal region clear yellow; longitudinal veins seamed with brown; r some distance from tip of R_1 .

Male, length, 8.5 to 10 millimeters; wing, 10 to 10.5. Female, length, 10 millimeters; wing, 11.

Rostrum and palpi black. Antennæ with first segment of scape black; second segment obscure yellow; flagellum brownish black, the proximal segments a little paler on basal half. Head gray. Mesonotum gray, prescutum with four rather ill-defined dark brown stripes. Pleura dark gray, indistinctly variegated with black. Halteres yellow. Legs with coxæ and trochanters obscure yellow; fore femora black with about the basal third yellow; other femora obscure yellow with about the distal third or less black, this a little more extensive on middle legs; remainder of legs brownish black. Wings brown-

ish yellow, base and cells C and Sc clearer yellow; longitudinal veins seamed with darker, this especially conspicuous on veins Cu and Cu₂; veins black, yellow in the flavous costal areas, including stigma. Venation: Sc₁ ending opposite midlength the deflection of R₄₊₅, Sc₂ at its tip; R₁ beyond r equal to or subequal to basal deflection of R₄₊₅; Rs longer than cell 1st M₂; Rs and R₂₊₃ run very close to R₁; m short; basal deflection of Cu₁ from one-third to one-half its length beyond the fork of M. Abdomen dark brown.

Habitat.—Japan (Saghalien and Hokkaido).

Holotype, male, Shikaripetsu, Hokkaido, August 26, 1922 (*T. Esaki*).

Allotype, female, Ponkikin, Hokkaido, September 2, 1922 (*T. Esaki*).

Paratypes, 3 males, Shikotsu, Hokkaido, September 24, 1922 (*T. Esaki*); 1 female, Shimizu, Saghalien, July 27, 1922 (*T. Esaki*); 1 male, Maoka, Saghalien, July 28, 1922 (*T. Esaki*).

Genus *ANTOCHA* Osten Sacken

Antocha OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila. (1859) 219.

No fewer than six species of *Antocha* were found in the present collection. The genus appears to be an ancient one that elsewhere in the world persists only as scattered species living under favorable conditions, chiefly in mountainous and hilly sections of the Holarctic Region. Hitherto not more than two species had been found in any one given region and the discovery of six species occurring in the vicinity of Sapporo, Hokkaido, was very surprising. The early stages of members of the genus, insofar as they are known, are spent in running water, and it seems probable that the numerous mountain streams of Japan have done much to favor the development and preservation of species of this genus. The Japanese species of the genus may be separated by means of the accompanying key.

A Key to the Japanese Species of the Genus Antocha.

[Males only.]

1. Legs very long and relatively stout, densely clothed with conspicuous erect setæ; in the male, opposable tubercles at tip of tibia and base of basitarsus; tarsi very short; in the female, tergal valves of ovipositor very short and stout, heavily chitinized, the ventral margin serrate. (Subgenus *Proantocha* Alexander.)..... 2.
- Legs relatively long and slender, clothed with inconspicuous, appressed setæ; in the male, legs unarmed and tarsi of normal length; in the

- female, all valves of ovipositor slender, their margins smooth. (Subgenus *Antocha* Osten Sacken.)..... 3.
2. Large species (wing of male over 12 millimeters); posterior tarsi very short, less than one-fourth the length of tibiae. (Honshiu.)
A. (P.) spinifer Alex.
 Smaller species (wing of male less than 8 millimeters); posterior tarsi more than one-fourth the length of tibiae. (Hokkaido.)
A. (P.) serricauda sp. nov.
3. Sc long, Sc_1 ending opposite fork of R_s or very nearly so..... 4.
 Sc shorter, Sc_1 ending some distance before fork of R_s 5.
4. Wings with stigma distinct, veins dark; male hypopygium with the glabrous dististyle heavily chitinized, apex produced into a slender point; aedeagus deflexed at tip. (Honshiu and Hokkaido.)
A. (A.) satsuma Alex.
 Wings with stigma lacking, veins pale; male hypopygium with the glabrous dististyle weakly chitinized, apex feebly notched; aedeagus straight. (Honshiu and Hokkaido.)..... *A. (A.) bifida* sp. nov.
5. Basistyle of male hypopygium without a setiferous lobe on mesal face at base; glabrous dististyle chitinized, gradually narrowed to an acute point; setiferous dististyle broadly dilated at base. (Hokkaido.)
A. (A.) dilatata sp. nov.
 Basistyle of male hypopygium with a small setiferous lobe on mesal face at base; glabrous dististyle feebly chitinized; setiferous dististyle not dilated at base..... 6.
6. Wings strongly tinged with brown; r-m near one-third the length of cell 1st M_2 ; legs relatively slender; male hypopygium with the glabrous dististyle slender, tapering to the subacute tip; gonapophyses straight. (Hokkaido.)..... *A. (A.) brevinervis* sp. nov.
 Wings nearly hyaline; r-m immediately before midlength of cell 1st M_2 ; legs conspicuous, long and relatively stout; male hypopygium with the glabrous dististyle broad, apex feebly bifid; gonapophyses sinuous. (Hokkaido.)..... *A. (A.) brevistyla* sp. nov.

Antocha (Proantocha) serricauda sp. nov.

Size medium (wing under 8 millimeters); general coloration yellow; tarsi of male more than one-fourth the length of tibiae.

Male, length, 5 to 6 millimeters; wing, 5.8 to 7.5. Female, length, 5 to 6 millimeters; wing, 6 to 7.5 millimeters.

Rostrum and palpi obscure yellow. Antennae pale brown, the basal segment more yellowish. Head pale yellowish brown, sparsely pruinose. Thorax yellow, prescutum and scutal lobes a trifle more fulvous. Halteres pale, knobs only slightly darker. Legs with coxae and trochanters yellow; remainder of legs yellowish testaceous, the terminal segments dark; legs conspicuously hairy, as in this group. Wings yellowish subhyaline; veins pale brownish yellow. Venation: r a little more than its length from tip of R_1 ; basal deflection of Cu_1 approximately one-

third its length, or less, before fork of M. Abdomen with tergites reddish brown, the caudal and lateral margins of segments clearer yellow; sternites obscure yellow. Male hypopygium (Plate 2, fig. 9) with the ninth tergite bearing two rounded lobes, these separated by a relatively broad U-shaped notch. Basistyle relatively slender, evenly covered with a few long setæ, these more numerous and more delicate on the mesal face; mesal face at base produced into a large setiferous lobe. Dististyles two, the glabrous style a broad, paddle-like blade with a conspicuous, erect marginal tooth; setiferous style clavate, densely setiferous. Gonapophyses straight, blunt at tips. Ædeagus subtended on either side by a large flaring blade. Ovipositor with the tergal valves short and very stout, heavily chitinized, the ventral edge with about a dozen teeth, the outer ones smaller, the basal ones more obtuse; a dense pencil of yellow setæ on either side of tergite, these directed caudad.

Habitat.—Japan (Hokkaido).

Holotype, male, Jozankei, August 20, 1922 (*T. Esaki*).

Allotype, female, Sapporo, June 25, 1921 (*S. Kuwayama*).

No. 105.

Paratopotypes, 13 males and females, August 19, 1922; paratype, 1 female, Shikaripetsu, August 26, 1922 (*T. Esaki*).

Antocha (Antocha) satsuma Alexander.

Antocha satsuma ALEXANDER, Ann. Ent. Soc. Am. 12 (1919) 332.

This species was described from Honshiu. The following specimens are in the present collection from Hokkaido:

Sapporo, August 17, 1922; Jozankei, August 19, 1922; Kamui-kotan, August 22, 23, 1922; Kamiotoineppu, August 24 to 26, 1922; Kamiokoppe, August 27, 1922 (*T. Esaki*).

The male hypopygium is figured on Plate 2, fig. 13.

Antocha (Antocha) bifida sp. nov.

General coloration pale ochereous, with three pale brown stripes; basal antennal segments pale, the terminal segments darkened; wings subhyaline, stigma lacking, veins pale; Sc long; male hypopygium with the ninth tergite having a conspicuous lateral tooth on either side; glabrous dististyle weakly bifid at apex.

Male, length, 4.2 to 4.8 millimeters; wing, 5.3 to 5.6. Female, length, 5.5 millimeters; wing, 6.5.

Rostrum pale, palpi light brown, the basal segment pale. Antennæ with scape pale, the basal flagellar segments pale, at

least basally; terminal segments oval, passing into uniform dark brown. Head dark gray. Mesonotal prescutum pale ochereous, with three pale brown stripes, the broad median stripe indistinctly split by a pale vitta; scutum brown, only the median area a little paler; scutellum and postnotum pale, the latter darker apically. Pleura reddish brown, very slightly pruinose. Halteres pale, knobs feebly darkened. Legs with coxæ and trochanters yellow; remainder of legs obscure yellow, the terminal tarsal segments darkening into brown. Wings subhyaline, stigma lacking or barely indicated; veins pale brown, those in the vicinity of stigma more yellowish. Venation: Sc long, Sc₁ ending immediately before or opposite fork of Rs; r faint, in alignment with r-m, one and one-half times its length from tip of R₁; veins R₂₊₃ and R₄₊₅ strongly divergent at base, R₂₊₃ being subperpendicular to end of Rs; basal deflection of Cu₁ at or before fork of M. Distribution of macrotrichiaë differing from the related *A. javanensis* Alexander; none at extreme tip of R₂₊₃; macrotrichiaë on R₄₊₅ including the distal two-thirds to three-fourths of veins; distal sections of veins M₁₊₂ and M₃ with macrotrichiaë almost to their bases; Cu₁ with more or fewer macrotrichiaë at tip. In *A. javanensis* there are two or three macrotrichiaë at the distal end of vein R₂₊₃; those on R₄₊₅, M₁₊₂ and M₃ virtually confined to the outer halves of the sections; none on distal section of Cu₁. Abdominal tergites dark brown, the caudal margins narrowly pale; basal sternites yellow, the subterminal sternites passing into brown, with pale caudal margins; hypopygium yellow. Male hypopygium (Plate 2, fig. 10) with the ninth tergite bidentate, a conspicuous lateral tooth on either side, widely separated by a setiferous U-shaped notch. Basistyles relatively slender, distribution of setæ even, no tubercle on mesal face at base. Dististyles two, the glabrous one rather strongly chinitized throughout its length, curved, apex weakly notched; setiferous style subequal to last in length, nearly uniform in width throughout its length. Gonapophyses relatively short, straight, tips subacute. Proctiger conspicuous, its caudal margin oval in outline.

Habitat.—Japan (Honshiu and Hokkaido).

Holotype, male, Jozankei, Hokkaido, August 19, 1922 (*T. Esaki*).

Allotype, female, Gifu, Mino Province, Honshiu, October 10, 1920 (*K. Takeuchi*).

Paratopotypes, 2 males; paratypes, 1 male, Sapporo, August 17, 1922 (*T. Esaki*); 4 males and females, Kamiotoineppu,

August 23, 24, 1922 (*T. Esaki*); 20 males and females, with the allotype, October 1 to 10, 1920.

In some cases, gray individuals are found, as is common in the genus *Antocha*.

Antocha (Antocha) dilatata sp. nov.

General coloration gray, prescutum with three brown stripes; wings subhyaline, stigma lacking, veins pale; Sc short; male hypopygium with basistyles lacking a setiferous lobe on mesal face at base; glabrous dististyle terminating in a chitinized point; setiferous style conspicuously dilated at base.

Male, length, 4.5 to 5 millimeters; wing, 5 to 5.5. Female, length, about 6 millimeters; wing, 6.5 to 7.

Rostrum pale brown, in some specimens brightening into yellow; mouth parts brown. Antennæ with the basal segments usually pale, the terminal segments passing into brown. Head dark brown, genæ light gray pruinose. Mesonotal prescutum dull gray with three brown stripes; scutum gray, lobes with brown centers; scutellum and postnotum light gray. Pleura gray. Halteres pale. Legs with coxæ and trochanters light yellow, fore coxæ gray pruinose at base; fore femora yellowish, the other femora brownish yellow; remainder of legs brown, the terminal tarsal segments dark brown. Wings subhyaline or whitish subhyaline, stigma lacking; veins pale and very indistinct. Venation: Sc short, Sc₁ ending some distance before fork of Rs; cell Sc₁ chitinized; r-m at from one-third to one-fourth the length of cell 1st M₂, the basal section of M₁₊₂ short and straight; basal deflection of Cu₁ from one-third to one-half its length before fork of M. Abdomen dark brown, sternites pale, brownish yellow; hypopygial basistyles conspicuously yellow. Male hypopygium (Plate 2, fig. 14) with the basistyles relatively long but stout, setæ uniformly distributed; no setiferous lobe on mesal face at base. Dististyles two, the glabrous style chitinized, especially apically, broader at base, tapering gradually to the gently curved, subacute apex; setiferous style conspicuously dilated on inner margin at base. Gonapophyses short, appearing as rather broad flattened blades. Ædeagus slender, sides at base weakly setiferous.

Habitat.—Japan (Hokkaido).

Holotype, male, Kamiotoineppu, August 24, 1922 (*T. Esaki*).

Allotopotype, female.

Paratopotypes, 13 males and females, August 24, 25, 1922 (some taken in copula); paratypes, 6 males and females, Jozean.

kei, August 19, 1922; 1 female, Lake of Akan, September 7, 1922; 1 female, Panketo, September 6, 1922 (*T. Esaki*).

Antocha (*Antocha*) *brevinervis* sp. nov.

General coloration gray, prescutum with three dark brown stripes; wings tinged with brown; vein Sc short; male hypopygium with a setiferous lobe on mesal face of each basistyle; gonapophyses short.

Male, length, 4 to 5.2 millimeters; wing, 4.3 to 6.4. Female, length, 5 millimeters; wing, 4.8.

Rostrum and palpi dark brown. Antennæ dark brown. Head brown, sparsely pruinose. Mesonotum grayish brown, prescutum with three dark brown stripes, the lateral margins clearer gray; remainder of mesonotum clearer gray, the scutal lobes infuscated. Pleura dark grayish brown. Halteres dark brown, the extreme base of stem yellow. Legs with coxæ dark brown, sparsely pruinose; trochanters dark brown, the fore trochanters brighter; remainder of legs dark brown, the posterior legs uniformly paler; setæ of legs short, appressed. Wings tinged with brown; stigma elongate, pale brown; veins dark brown. Venation: Sc short, Sc₁ ending some distance before end of Rs; the part of r within stigma faint; basal deflection of Cu₁ only a short distance before fork of M. Abdomen dark brown, pruinose. Male hypopygium (Plate 2, fig. 12) with basistyles on mesal face at base with a small obtuse tubercle, densely set with setæ; lateral face of each basistyle glabrous or nearly so. Glabrous dististyle uniformly colored throughout, apex subacute. Gonapophyses shorter, stouter and straighter than in *A. satsuma*.

Habitat.—Japan (Hokkaido).

Holotype, male, Jozankei, August 19, 1922 (*T. Esaki*).

Allotopotype, female.

Paratopotype, 1 male; paratypes, 1 male, Lake of Akan, September 4, 1922 (*T. Esaki*), 1 male, in poor condition, Sapporo, June 25, 1921 (*S. Kuwayama*), No. 102.

The Jozankei specimens are very small (the minimum measurements given) but undoubtedly refer to this species.

Antocha (*Antocha*) *brevistyla* sp. nov.

Size large (wing of male over 7 millimeters); general color ochereous, pronotum and prescutum darker medially; legs dark brown; wings with Sc short; male hypopygium with dististyles relatively short, the glabrous style dilated into a blade that is feebly notched at apex.

Male, length, about 5.3 millimeters; wing, 7.2.

Rostrum ocherous, palpi black. Antennæ dark brown throughout. Head dark, silvery gray pruinose on anterior part of vertex. Pronotum ocherous, broadly dark brown medially. Mesonotal prescutum reddish brown, darker brown medially; lateral stripes obliterated; scutum and scutellum pale brown; postnotum pale brown, darker posteriorly. Pleura pale, sternopleura infuscated. Halteres pale, knobs infuscated. Legs with coxæ pale, the outer faces darkened; trochanters pale, dark brown apically; remainder of legs dark brownish black, the femoral bases a little paler; legs relatively stout, but elongate; claws with a long, slender, basal spine. Wings subhyaline; stigma barely indicated; veins pale brown. Venation: Sc ending some distance before fork of Rs, as in *A. brevinervis*, costa beyond this fusion slightly incrassated and apparently filling cell Sc₁; r very faint; r-m just before midlength of cell 1st M₂, the basal section arcuate, the distal section straight; basal deflection of Cu₁ immediately before fork of M. Abdominal tergites obscure brownish yellow, with indications of a darker median stripe; sternites obscure yellow, the lateral margins darkened. Male hypopygium (Plate 2, fig. 11) with basistyles relatively slender, the mesal face grooved, at the bottom of this groove a small, oval, setiferous lobe. Dististyles unusually short, the glabrous one feebly expanded apically into a blade, apex weakly notched; setiferous style curved, clavate, with abundant short but conspicuous setæ. Gonapophyses slender, sinuous, their tips acute. Proctigers broad, almost straight across their caudal margins, their surface covered with abundant microscopic setæ.

Habitat.—Japan (Hokkaido).

Holotype, male, Sapporo, August 17, 1922 (*T. Esaki*).

Genus PEDICIA Latreille

Pedicia LATREILLE, Hist. Nat. Crust. et Ins. 4 (1809) 255.

Daimiotipula MATSUMURA, Thous. Ins. Japan, Add. 2 (1916) 463.

Pedicia daimio (Matsumura).

Daimiotipula daimio MATSUMURA, Thous. Ins. Japan, Ann. 2 (1916) 463.

Matsumura's type, a female, was from Sapporo, Hokkaido. A pair in the present collection is from Abashiri. The unknown male may be described as follows:

Allotype, male, length, 24 millimeters; wing, 23.

Antennal scape black, contrasting with the pale brown flagellum. Vertical tubercle high, conical. Head dark gray. Median prescutal stripe entire or very indistinctly bisected by a capillary pale vitta. Femora yellow, tips conspicuously blackened, more narrowly and abruptly on the posterior femora. Wings with the pattern dark brown; the brown band along cord connects with a narrow border uniting the spot at origin of Rs with the stigmal region, but isolates a large hyaline spot before stigma, immediately beneath tip of R_1 ; base of cell Cu very narrowly darkened. Venation: Rs square at origin, opposite Sc_2 ; petiole of cell M_1 only a little longer than m; cell 2d A broad. Abdomen with the basal tergite brightened, except medially; intermediate tergites brown, base narrowly pale; terminal segments dark brown, gray pruinose.

Allotype, male, Abashiri, Hokkaido, August 30, 1922 (*T. Esaki*).

Genus RHAPHIDOLABINA Alexander

Rhaphidolabina ALEXANDER, Proc. Acad. Nat. Sci. Phila. (1916) 540.

Rhaphidolabina gibbera Alexander.

Rhaphidolabina gibbera ALEXANDER, Ann. Ent. Soc. Am. 14 (1921) 121.

Toyohara, Saghalien, July 20, 1922 (*T. Esaki*); Maoka, Saghalien, July 28, 1922 (*T. Esaki*); Manui, Saghalien, August 3, 1922 (*T. Esaki*).

The species was described from rather imperfect material taken in central Honshiu. The following additional details of coloration should be given: The fore and middle legs are very different in color from the posterior legs, the femora being abruptly and entirely brownish black, the tibiae and tarsi conspicuously light yellow, only the terminal segments of the latter being a little darkened.

The following notes by the collector are of interest. "These flies swarm like gnats and the black fore and middle femora look very strange in flight."—*Teiso Esaki*.

Genus POLYANGAEUS Doane

Polyangaeus DOANE, Journ. N. Y. Ent. Soc. 8 (1900) 196.

Polyangaeus gloriosus sp. nov.

General coloration yellowish ochereous; antennal flagellum yellow; legs yellow, femora and tibiae broadly and conspicuously blackened terminally; wings subhyaline, with a brown, cross-

banded pattern, the costal cell clear, sparsely variegated with darker; supernumerary cross veins in cells R_3 , R_4 , M_1 , and M .

Male, length, 11 to 12 millimeters; wing, 9.6 to 10.

Rostrum and palpi brownish black. Antennæ very small, the first scapal segment black, the second dark brown; flagellum conspicuously light yellow, segments subglobular. Head dark brown, the occipital region a little paler. Pronotum broadly dark brown medially, the lateral portions ochereous. Mesonotal prescutum yellowish ochereous, with three broad reddish brown stripes that are practically confluent; scutal lobes reddish brown on their cephalic halves; scutellum and postnotum yellow. Pleura yellow, mesopleura indistinctly suffused with darker. Halteres pale, knobs weakly infuscated. Legs with coxæ yellow, the middle and posterior coxæ infuscated on their outer faces; trochanters yellow, their caudal margins slightly infuscated; femora and tibiæ yellow, tips broadly and very conspicuously brownish black, these areas approximately equal on all segments; basitarsi yellow, passing into brown at tip; remainder of tarsi dark brown. Wings subhyaline, with a handsome bright brown cross-banded pattern that is generally similar to that found in certain species of *Epiphragma*, distributed as follows: At base of wing; at origin of R_s , including both basal cells; along cord, completely traversing wing; at outer deflection of R_2 ; a broad subterminal band having m and the supernumerary cross veins in cells R_3 , R_4 and M_1 as centers, continued to wing margin along veins; all of these brown areas are bordered with still darker brown; a series of from four to eight brown spots in cell Cu ; area immediately behind vein Cu darkened; still darker brown areas at h ; in cell C above Sc_2 ; in outer end of cell C ; at end of cell Cu and vein 1st A ; a large blotch at end of vein 2d A , and a smaller area in base of cell 1st A ; veins yellow, darker in the infuscated areas. Venation: Sc_2 ending just before origin of R_s ; outer deflection of R_2 from one to two times its length from tip of R_1 ; R_s angulated and spurred at origin; R_2 spurred immediately beyond base; cell R_3 petiolate, the petiole about equal to $r-m$; cell 1st M_2 closed; petiole of cell M_1 a little longer than m ; basal deflection of Cu_1 about one-third its length beyond fork of M ; supernumerary cross veins distributed as follows: in cell R_3 near the distal end, in cell R_4 at two-thirds the length; in cell M_1 at from one-third to one-half the length, in cell M opposite Sc_2 . In the type, cell M_1 is sessile and unusually long, the supernumerary cross vein being at two-thirds the length. In a para-

type, true *r* is present in both wings, just beyond spur on *R*. Basal abdominal tergites brown, paler laterally; basal sternites yellow, the caudal margins narrowly ringed with dark brown; terminal segments uniformly dark brown.

Habitat.—Japan (Saghalien).

Holotype, male, Shimizu, July 27, 1922 (*T. Esaki*).

Paratopotypes, 3 males.

Polyangaeus gloriosus is the largest and most beautiful species of the genus yet discovered.

Genus DICRANOTA Zetterstedt

Dicranota ZETTERSTEDT, Ins. Lapponica, Dipt. (1838) 851.

Dicranota yezoensis sp. nov.

Male, length, 6.3 millimeters; wing, 7.

Generally similar to *D. nipponica* Alexander, differing as follows: Antennæ of male elongate, if bent backward extending to mid-distance between base of wing and haltere; flagellar segments elongate, shiny black, with a white pubescence. General coloration of prescutum darker gray, stripes less contrasted. Wings with ground color somewhat darker, stigma distinct, dark brown; a distinct brown cloud extending from fork of *R*s to end of *r-m*. Venation: *R*s angulated and slightly spurred at origin; *m* present but faint, closing cell 1st *M*₂; petiole of cell *M*₁ about one-half longer than cell. Macrotrichiae of wing veins longer and more conspicuous.

Habitat.—Japan (Hokkaido).

Holotype, male, Lake of Akan, September 4, 1922 (*T. Esaki*).

Genus RHAPHIDOLABIS Osten Sacken

Rhaphidolabis OSTEN SACKEN, Mon. Dipt. N. Am. 4 (1869) 284.

Rhaphidolabis flavibasis Alexander.

Rhaphidolabis flavibasis ALEXANDER, Ann. Ent. Soc. Am. 12 (1919) 343.

One female from Toyohara, Saghalien, July 17, 1922 (*T. Esaki*). The species was described from Honshiu, but has not yet been found in Hokkaido.

Rhaphidolabis subconsors sp. nov.

Male, length, about 4.5 millimeters; wing, 6.1.

Generally similar to *R. consors* Alexander, differing as follows: Pronotum, mesonotal prescutum, scutum, postnotum, and

thoracic pleura dark gray, scutellum and posterior portions of the scutal lobes reddish; prescutum with a distinct black median stripe and less distinct lateral stripes. Wings with petiole of cell M_3 only as long as the basal deflection of Cu_1 . Male hypopygium with the mesal apical angle of basistyle produced into a short, broad, blunt lobe, the truncate apex of which is densely set with strong setæ. Outer dististyle triangular, fleshy, surface with abundant, hairlike setæ; inner dististyle smooth, large, and flattened. Lateral gonapophyses appearing as long, strongly curved hooks, the long acute tips of which are produced mesad and cephalad, almost contiguous on midline of body.

Habitat.—Japan (Hokkaido).

Holotype, male, Lake Shikotsu, September 24, 1922 (*T. Esaki*).

Tribe HEXATOMINI

Genus *ULA* Haliday

Ula HALIDAY, Ent. Mag. 1 (1833) 224.

The genus *Ula* includes six described species, all being Holarctic with the exception of a single Javanese species. The relationships of this genus are in doubt, the details of structure of the adult pointing to the tribe Pediciini, those of the larvæ and pupæ to the Hexatomini. The present collection contained two additional undescribed species.

Ula perelegans sp. nov.

General coloration gray; antennæ long; wings with a heavy brown pattern; cell 1st M_2 relatively large.

Female, length, about 5.5 millimeters; wing, 8.

Rostrum dark gray, palpi black. Antennæ long for this sex, if bent backward extending to base of halteres, black throughout. Head light gray. Pronotum light gray. Mesonotum black, gray pruinose, on prescutum leaving a median black stripe exposed. Pleura pale brown, sparsely pruinose, the dorsopleural membrane obscure yellow. Halteres yellow, knobs feebly infuscated. Legs with coxæ and trochanters yellow; femora brown, bases broadly yellow, narrowest on forelegs where about the basal quarter is included; on the posterior legs the brown includes only the relatively narrow apices; tibiæ and tarsi pale brown, tarsi darker. Wings pale yellow with a heavy brown pattern, distributed as follows: A small spot at Sc_2 ; large spots at origin

of R_s , tip of Sc_1 and at r , the latter two delimiting a conspicuous yellowish stigmal area, the former confluent with a conspicuous seam along cord, continued to wing margin along vein Cu_2 ; outer end of cell 1st M_2 seamed with brown; veins brown. Venation: Sc_2 near midlength of distance between arculus and origin of R_s ; r its own length from tip of R_1 ; basal deflection of R_{4+5} very short; $r-m$ correspondingly lengthened, feebly arcuated; cell 1st M_2 rather large, as long as vein Cu_1 beyond it; basal deflection of Cu_1 about one-fourth its length beyond fork of M . Abdominal tergites infuscated, especially the basal and subterminal segments; sternites light yellow; ovipositor with valves strongly upcurved.

Habitat.—Japan (Hokkaido).

Holotype, female, Abashiri, August 30, 1922 (*T. Esaki*).

Ula cineta sp. nov.

General coloration shiny yellowish brown; antennæ long; wing pattern faintly indicated; cell 1st M_2 small; abdominal segments dark brown, the caudal margins narrowly ringed with obscure yellow.

Female, length, 5.6 to 5.8 millimeters; wing, 6.3 to 6.8.

Rostrum and palpi black. Antennæ elongate, if bent backward extending at least to base of halteres; scapal segments pale, the flagellar segments dark. Head dull gray. Mesonotal prescutum shiny yellowish brown, scutellum and postnotum darker brown. Pleura light brown. Halteres pale, knobs infuscated. Legs with coxæ and trochanters pale brownish yellow, fore coxæ a little infuscated basally; legs pale brown, tibiæ and tarsi darker; extreme tips of femora infuscated. Wings faintly tinged with brown, with faint indications of darker markings at origin of R_s , along cord, and at either end of the faintly indicated stigma; veins uniformly pale brown. Venation: Sc_2 about three-fifths the distance between arculus and origin of R_s ; cell 1st M_2 relatively small, shorter than the distal section of Cu_1 . Abdomen dark brown, the caudal margins of segments narrowly ringed with obscure yellow. Ovipositor with the tergal valves strongly upcurved to the acute tips.

Habitat.—Japan (Hokkaido).

Holotype, female, Akan, September 3, 1922 (*T. Esaki*).

Paratype, 1 female, Teppetsu, September 9, 1922 (*T. Esaki*).

Genus **EPIPHRAGMA** Osten Sacken

Epiphragma OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila. (1859) 238.

Epiphragma subinsignis Alexander.

Epiphragma subinsignis ALEXANDER, Trans. Am. Ent. Soc. 46 (1920) 11, 12.

One female from Maruyama, near Sapporo, Hokkaido, August 17, 1922 (*T. Esaki*). The types are from Saitama and Mount Takao, near Tokyo, Honshiu.

Genus **LIMNOPHILA** Macquart

Limnophila MACQUART, Hist. Nat. Ins., Dipt. (1834) 95.

The type of the genus *Limnophila* is *L. pictipennis* Meigen, this having been designated by Westwood in 1840. One species of the typical subgenus was included in the present material. The other species fall in various subgeneric groups, some of which may not be strictly congeneric when better known.

Limnophila (Limnophila) japonica Alexander.

Limnophila japonica ALEXANDER, Can. Ent. 45 (1913) 316, 317.

Saghalien: Toyohara, July 18, 1922; Manui, August 3, 1922. Hokkaido: Kamiotoineppu, August 24, 1922.

The Saghalien specimens have the basal flagellar segment black with only the extreme base pale, but seem to be referable to this species.

Limnophila inconcussa Alexander.

Limnophila inconcussa ALEXANDER, Can. Ent. 45 (1913) 313, 314.

This is a common and widely distributed crane fly, ranging from Hokkaido to Taiwan. The present collection includes the following material, collected by Doctor Esaki:

Hokkaido: Kamiotoineppu, August 23, 1922; Shikaripetsu, August 26, 1922; Abashiri, August 31, 1922; Akan, September 6, 1922.

Limnophila unicoides sp. nov.

Allied to *L. unica* Osten Sacken; general coloration dark chocolate brown; antennæ of male elongate; wings with a faint brown tinge; stigma large, dark brown; a brown cloud at r-m; cell 1st M_2 large, cell M_1 deep.

Male, length, about 9 millimeters; wing, 8. Female, length, 8.5 to 10 millimeters; wing, 9 to 9.5.

Rostrum and palpi brownish black, the former dusted with gray. Antennæ elongate, the basal segment dark brown;

second scapal segment obscure yellow; flagellum dark brown; segments elongate. Head brown, pruinose. Mesonotum dark chocolate brown, with a very sparse yellowish pollen, scutellum and postnotum more pruinose. Pleura dark brown, gray pruinose. Halteres obscure yellow, knobs infuscated. Legs with coxæ obscure yellow, their bases infuscated; trochanters yellow; remainder of legs dark brown, the femoral bases narrowly obscure brownish yellow, narrowest on forelegs, broadest on hind legs. Wings with a faint brownish tinge; stigma large, dark brown; a conspicuous brown cloud at r-m and the basal deflection of R_{4+5} ; an indistinct cloud at origin of Rs; veins dark brown. Venation: Sc long, Sc_1 ending slightly beyond fork of Rs, the usually longer Sc_2 at its extreme tip; Rs long; R_{2+3} subequal to the distal section of R_2 ; r a little shorter than tip of R_1 ; inner ends of cells R_3 , R_5 and 1st M_2 in alignment; cell 1st M_2 large, widened distally; petiole of cell M_1 about one-half longer than m, cell M_1 being very deep; basal deflection of Cu_1 before or near midlength of cell 1st M_2 . A paratype has an adventitious cross vein in cell R_3 of one wing. Abdominal tergites dark brown, the basal sternites obscure brownish yellow; hypopygium black. In female, sternites are uniformly darkened. Male hypopygium with the mesal face of basistyle produced caudad as a stout, blunt lobe; dististyles two, the outer style a flattened, bladelike structure that terminates in a slender, curved, black spine; inner style slender, foot-shaped, at apex bent cephalad at a right angle into a long, slender beak; on the caudal margin near base, a slender, black, slightly curved spine. Gonapophyses appearing as two sets of black curved spines, directed mesad, the lateral pair longer and more strongly curved.

Habitat.—Japan (Saghalien and Hokkaido).

Holotype, male, Shimizu, Saghalien, July 27, 1922 (*T. Esaki*).

Allotype, female, Kamiotoineppu, Hokkaido, August 24, 1922 (*T. Esaki*).

Paratypes, 1 female, Teppetsu, Hokkaido, September 9, 1922 (*T. Esaki*); 1 female, Akan, Hokkaido, September 4, 1922 (*T. Esaki*).

Limnophila subpoetica sp. nov.

Allied to *L. poetica* Osten Sacken; general coloration reddish brown; femora black, broadly yellowish basally; wings tinged with grayish yellow, stigma dark brown; Rs long, cell 2d A broad.

Male, length, 10 millimeters; wing, 9.5.

Rostrum and palpi brownish black. Antennæ moderately elongate, if bent backward extending to beyond base of abdomen; scape dark brown; basal flagellar segment obscure yellow; remainder of flagellum dark brown. Head gray. Mesonotal prescutum reddish brown, sparsely pollinose, scutellum and postnotum slightly more pruinose. Pleura concolorous. Halteres pale, knobs a little darker. Legs with coxæ and trochanters obscure yellow; femora black, bases broadly obscure yellow, narrowest on forelegs where less than the basal third is included, broadest on hind legs where more than the basal half is included; tibiæ brown, passing into dark brownish black at tips and on tarsi. Wings with a grayish yellow tinge, brighter yellow at base and in cells C and Sc; stigma oval, dark brown; narrow and inconspicuous brown seams at origin of Rs, along cord and outer end of cell 1st M_2 , and at wing apex. Venation: Rs long, square and spurred at origin, in alignment with R_{2+3} ; r at tip of R_1 ; inner ends of cells R_3 , R_5 and 1st M_2 in approximate alignment; cell M_1 present, a little longer than its petiole; cell 1st M_2 rectangular, the basal deflection of Cu_1 about one-third its length beyond fork of M; cell 2d A much broader than in *L. kuwayamai* Alexander. Abdomen reddish brown, variegated with black; terminal segments uniformly blackened, including hypopygium. Male hypopygium with the ninth tergite produced into a long, fingerlike lobe on either side of median line; dististyles two, the outer long and slender with the narrow apex strongly curved, the inner dististyle dilated basally, apex paler. Gonapophyses small, curved, base of each produced laterad into a small, bidentate lobe.

Habitat.—Japan (Saghalien).

Holotype, male, Toyohara, July 25, 1922 (*T. Esaki*).

Limnophila nemoralis (Meigen) var.

Limnobia nemoralis MEIGEN, Syst. Besch. 1 (1818) 126.

One female from Toyohara, Saghalien, July 20, 1922 (*Teiso Esaki*) cannot be distinguished from European material. It is possible that the male sex will show subspecific differences.

Limnophila (*Phylidorea*) *subadusta* sp. nov.

General coloration dull reddish brown; head gray; legs black, the femoral bases broadly yellow; wings tinged with yellow, sparsely spotted and seamed with brown; abdomen dark brown, segments narrowly ringed caudally with pale.

Female, length, 9.5 millimeters; wing, 8.

Rostrum and palpi black. Antennæ with the basal segment dark brown; second scapal and basal one or two flagellar segments yellow, the terminal segments dark brown. Head gray. Pronotum dark brown. Mesonotal prescutum dull reddish brown, prescutum more infuscated medially, surface feebly pollinose. Pleura reddish brown, mesepisternum infuscated, surface slightly pollinose. Halteres yellow, knobs very slightly infuscated. Legs with coxæ and trochanters yellow; femora black, their bases bright yellow, on forelegs including about the basal third, more extensive on the other legs; tibiæ brownish black; tarsi black. Wings tinged with yellow, base and cells C and Sc more yellowish; stigma conspicuous, oval, dark brown; wing tip suffused with brown; conspicuous but narrow brown spots and seams at origin of Rs; along cord and outer end of cell 1st M_2 ; fork of M_{1+2} ; veins brownish black, paler in the flavous areas. Venation: Sc_1 ending immediately before fork of Rs, Sc_2 at its tip; Rs long for a member of the *ferruginea* group, one-half longer than cell 1st M_2 , square and spurred at origin; R_{2+3} about equal to basal deflection of R_{4+5} ; r at tip of R_1 ; petiole of cell M_1 about as long as cell; basal deflection of Cu_1 near midlength of cell. Abdominal tergites dark brown, apices of segments indistinctly paler; basal sternites obscure yellow, the remaining sternites concolorous with tergites. Ovipositor with the valves dark horn color.

Habitat.—Japan (Saghalien).

Holotype, female, Manui, August 3, 1922 (*T. Esaki*).

Limnophila (Phylidorea) *sapporensis* Alexander.

Limnophila sapporensis ALEXANDER, Insec. Inscit. Menst. 9 (1921) 181, 182.

The following records are included in the present collection: Saghalien: Manui, August 3, 1922; Odasam, August 5, 1922; Odomari, August 8, 1922 (*T. Esaki*).

The type locality is Hokkaido.

Genus *PILARIA* Sintenis

Pilaria SINTENIS, Sitzber. Nat. Ges. Dorpat 8 (1888) 398.

Species of the genus *Pilaria* are found throughout the Holarctic Region and in Madagascar.

Pilaria dorsalis sp. nov.

Size large (wing of female, over 10 millimeters); head dull black; antennæ elongate; general coloration of thorax obscure

reddish yellow, prescutum and scutal lobes shiny black; femora and tibiae obscure brownish yellow.

Female, length, about 9 millimeters; wing, 10.5 to 12.

Rostrum pale brown, palpi black. Antennae elongate, scape black, the basal flagellar segment pale at base; remainder of organ black. Head dull black, light gray pruinose. Pronotum very narrow, obscure yellow, darker anteromedially. Mesonotum shiny black, the region of the pseudosutural foveae obscure yellow; lateral margins very narrowly of the same color; scutum obscure yellow medially, lobes shiny black, narrowly connected across the median line; scutellum and postnotum obscure reddish brown, the former sometimes blackened medially. Pleura obscure reddish yellow. Halteres yellow, knobs weakly infuscated. Legs with coxae and trochanters yellow; femora and tibiae obscure brownish yellow, tips narrowly and indistinctly infuscated; tarsi dark brown. Wings with a faint brownish tinge, base and costal region more yellowish; stigma very small and faint, brown, veins dark brown. Venation: Sc ending just before fork of Rs, Sc₂ at tip of Sc₁; Rs long, straight, base arcuated; r at fork of R₂₊₃; cell M₁ about as long as its petiole; basal deflection of Cu₁ near two-thirds the length of cell 1st M₂. Abdomen dark brown, sternites a little paler. Ovipositor with the long, acicular valves horn-colored, basal plate black.

Habitat.—Japan (Saghalien and Hokkaido).

Holotype, female, Konuma, Saghalien, July 17, 1922 (*T. Esaki*).

Paratype, female, Sapporo, Hokkaido, June 19, 1921 (*M. Hori*), No. 55.

Genus *ERIOCERA* Macquart

Eriocera MACQUART, Dipt. Exot. 1 (1838) 74.

The very large genus *Eriocera* is represented in the collection by two species belonging to the *spinosa* group of the genus. Their nearest allies are found in the Nearctic Region.

Eriocera *jozana* sp. nov.

Male, length, 14 millimeters; wing, 22; antenna, 61.

Generally similar to *E. stricklandi* Edwards, differing as follows:

Antennae with the enlarged basal segment ochereous on the ventral half; flagellar segments 1 to 4 gradually elongated,

the entire organ more than four times the length of body. Vertical tubercle very large and conspicuous. Thoracic vestiture long and conspicuous, erect; lateral margins of prescutum not conspicuously brightened, pruinose; median prescutal stripe indistinctly bifid posteriorly. Legs with the black tips of fore femora narrower; posterior femora black with only the extreme base brightened; tibiae not darkened basally. Wings with stigma clearly defined, oval, brown; cell 1st M_2 long and narrow, rectangular; cell M_1 about equal in length to its petiole. Abdominal segments dark brown, ocherous laterally, the caudal margins of the posterior sternites broadly pale.

Habitat.—Japan (Hokkaido).

Holotype, male, Jozankei, August 19, 1922 (*T. Esaki*).

Eriocera sachalinensis sp. nov.

Belongs to the *spinosa* group; antennæ of male shorter than body; mesonotal prescutum gray with four conspicuous dark brown stripes; cell M_1 present.

Male, length, 16 to 18 millimeters; wing, 20 to 21; antenna, 11.5 to 12.

Rostrum and palpi brownish black. Antennæ of moderate length, shorter than body; basal segment dark, reddish basally beneath; flagellum black, segments 1 to 4 gradually more elongated. Head brown, gray pruinose; a conspicuous reddish brown area on either side of the vertical tubercle. Mesonotal prescutum gray, with four conspicuous dark brown stripes; scutum gray, each lobe with a conspicuous, dark brown, central blotch; scutellum brownish gray, more yellowish laterally, clothed with abundant long, pale setæ; postnotum brownish plumbeous. Pleura dark colored, light gray pruinose. Halteres light brownish ocherous, knobs dark brown. Legs with coxæ light gray; trochanters brown; femora dark brown, bases broadly and conspicuously obscure fulvous, on the posterior legs occupying a little less than the basal half; remainder of legs brownish black. Wings with a strong brownish yellow tinge, base and cells C and Sc more saturated; stigma small, oval, dark brown; veins dark brown. Venation: r near midlength of vein R_2 ; cell M_1 present, longer than its petiole. Abdomen dark brown, pruinose; lateral margins of tergites narrowly ocherous.

Habitat.—Japan (Saghalien).

Holotype, male, Takinosawa, July 26, 1922 (*T. Esaki*).

Paratypes, 1 male, Shimizu, July 27, 1922 (*T. Esaki*), 1 male, Maoka, July 28, 1922 (*T. Esaki*).

Genus **ELEPHANTOMYIA** Osten Sacken

Elephantomyia OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila. (1859)
220.

Elephantomyia (*Elephantomyia*) *hokkaidensis* sp. nov.

General coloration shiny brownish yellow; legs with femora dark brown, tibiae and tarsi brownish yellow; wings tinged with yellow, apex infuscated; abdomen yellow, tergites with a longitudinal median stripe; sternites ringed caudally with black.

Male, length (excluding rostrum), 6 to 10 millimeters; wing, 8.5 to 12. Female, length (excluding rostrum), 9 to 11 millimeters; wing, 9 to 11.

Rostrum longer than body, brown, including palpi. Antennae with scape dark brown; basal flagellar segments brownish yellow, becoming more infuscated toward tip of the organ. Head yellowish pruinose anteriorly, more yellow to brownish yellow behind. Pronotum infuscated medially. Mesonotum shiny brownish yellow to brown, without markings. Pleura concolorous. Halteres pale, knobs weakly infuscated. Legs with coxae and trochanters yellowish testaceous; femora brown, soon passing into dark brown; tibiae and basal segments of tarsi brownish yellow, the terminal tarsal segments infuscated. Wings tinged with yellow; apex distinctly infuscated; stigma elongate-oval, brown; cord and outer end of cell 1st M_2 narrowly and indistinctly clouded with darker; veins dark brown. Venation: Sc_1 ending nearly opposite fork of Rs , Sc_2 at tip of Sc_1 ; cell 1st M_2 large, rectangular; basal deflection of Cu_1 close to midlength of cell. Abdomen yellow, tergites with a median black longitudinal stripe, in some female individuals broken into triangles; sternites conspicuously ringed caudally with black; a black subterminal ring in male; hypopygium obscure yellow. Male hypopygium with the mesal face of basistyles densely setiferous; outer dististyle slender, suddenly curved at apex, before tip on the outer side with a small tooth; inner style a little longer, enlarged on basal half, setiferous. Gonapophyses slender, produced into a filiform point. Penifilum coiled in a transverse spring, suggesting a watch spring.

Habitat.—Japan (Hokkaido).

Holotype, male, Abashiri, August 30, 1922 (*T. Esaki*).

Allotopotype, female.

Paratopotypes, 2 males, 3 females; paratypes, 7 males and females, Kamiotoineppu, August 23, 25, 1922 (*T. Esaki*); 5 males and females, Shikaripetsu, August 26, 1922 (*T. Esaki*); 2 males and females, Kamiokoppe, August 27, 1922 (*T. Esaki*); 1 female, Ponkikin, September 2, 1922 (*T. Esaki*); 7 males and females, Akan, September 3, 4, 1922 (*T. Esaki*); 4 males and females, Panketo, September 6, 1922 (*T. Esaki*); 6 males and females, Shikotsu, September 24, 1922 (*T. Esaki*).

Most of the above specimens were taken while feeding on nectar of various Compositæ plants; a few came to light.

Genus *MOLOPHILUS* Curtis

Molophilus CURTIS, Brit. Ent. (1833) 444.

In addition to the new species described herewith, the collection included female specimens of at least one additional species of *Molophilus* that cannot be determined more accurately.

Molophilus albibasis sp. nov.

General coloration black; antennæ short; halteres white; wings faintly tinged with brown, their bases white; male hypopygium with the mesal apical angle of basistyle terminating in a powerful black spine.

Male, length, about 4 millimeters; wing, 4.5.

Rostrum and palpi black. Antennæ short, dark brown. Head black. Mesonotum black, pleura dark brownish black. Halteres white. Legs dark brownish black. Wings with a faint brownish tinge, base conspicuously whitish to a short distance beyond arculus; veins conspicuously dark brown. Venation: Vein 2d A comparatively short, ending before level of fork of M. Abdomen dark brown, including hypopygium. Male hypopygium very distinct in structure; each basistyle stout, the lateral apical angle produced caudad into a long, stout, cylindrical, setiferous lobe that is as long as any of the elements of hypopygium; mesal apical angle of basistyle produced into a shorter, glabrous lobe that bears near its tip a powerful, curved, black spine. Dististyles two, lying in the notch between the lobes of basistyle; longest style slender, bifid near its tip, the arms thus formed relatively long and slender; inner style a short, blackened blade, slightly curved beyond mid-length, the margin with microscopic spinulæ.

Habitat.—Japan (Saghalien).

Holotype, male, Toyohara, July 16, 1922 (*T. Esaki*).

Genus **ERIOPTERA** Meigen

Erioptera MEIGEN, Illiger's Mag. 2 (1803) 262.

Erioptera (*Erioptera*) *elegantula* Alexander.

Erioptera elegantula ALEXANDER, Can. Ent. 45 (1913) 290, 291.

Doctor Esaki's material included the following records: Hokkaido: Sapporo, August 17, 1922; Kamuikotan, August 22, 1922; Abashiri, August 31, 1922.

Erioptera (*Erioptera*) *xanthoptera* sp. nov.

General coloration brown; antennæ pale brown; halteres and legs obscure yellow; wings with a strong yellowish tinge.

Female, length, 6 millimeters; wing, 7.

Rostrum and palpi pale brown. Antennæ pale brown throughout. Head light brown, sparsely pollinose, occiput slightly more fulvous. Mesonotum brown with a light yellow pollinosity. Pleura light brown. Halteres short, obscure yellow, knobs a very little darker. Legs with coxæ and trochanters concolorous with pleura; remainder of legs obscure yellow, the terminal tarsal segments infuscated. Wings with a strong yellow tinge, veins darker yellow. Venation: Vein 2d A strongly sinuous. Abdominal tergites brown, the caudal and lateral margins of segments a little brighter; sternites brownish black. Ovipositor with the tergal valves strongly upcurved.

Habitat.—Japan (Saghalien).

Holotype, female, Konuma, July 17, 1922 (*T. Esaki*).

Erioptera (*Erioptera*) *flavohumeralis* sp. nov.

Mesonotal prescutum yellow, with three conspicuous brown stripes; halteres obscure yellow; femora dark brown, bases broadly pale; wings tinged with brownish yellow.

Male, length, about 5.5 millimeters; wing, 5.7. Female, length, about 6 millimeters; wing, 6.2.

Rostrum and palpi black. Antennæ with the basal segment brownish black, the second segment pale brown; flagellum dark brown. Head pale. Pronotum obscure yellow, darker medially. Mesonotal prescutum yellow, with three conspicuous brown stripes, the humeral region broadly yellow; scutum yellow, lobes with brown centers; scutellum and postnotum obscure yellow, the latter darker posteriorly. Pleura ocherous, very sparsely pruinose; sternopleura darker. Halteres obscure yellow. Legs with coxæ yellow, fore coxæ darker basally; trochanters yellow; femora dark brown, bases broadly paler; tibiae and basal segments of tarsi obscure yellow, the terminal segments darker.

Wings tinged with brownish yellow, cells beyond cord darker, especially near wing tip; veins brownish yellow. Venation: Vein 2d A strongly sinuous. Abdomen dark brown. Male hypopygium (Plate 2, fig. 21) with the outer dististyle slender, at apex dilated into a semicircular blade, before apex of which on the outer margin with a conspicuous erect spine. Gonapophyses widely separated at base, directed mesad, before tips slightly dilated and produced into acute blackened points.

Habitat.—Japan (Saghalien).

Holotype, male, Toyohara, July 19, 1922 (*T. Esaki*).

Allotopotype, female.

Erioptera (Erioptera) horii sp. nov.

General coloration light yellow; head silvery whitish; halteres with dark brown knobs.

Male, length, 4.5 to 4.7 millimeters; wing, 5.5. Female, length, 5.5 millimeters; wing, 5.6 to 5.8.

Rostrum yellow, palpi dark brown. Antennæ yellow, the terminal segments darkened, the basal segment sparsely pruinose. Head silvery white; eyes large. Pronotum white. Mesonotal prescutum pale ochreous yellow, unmarked, the lateral margins paler. Pleura whitish yellow. Halteres yellow, knobs conspicuously dark brown. Legs with coxæ and trochanters yellowish testaceous; remainder of legs yellow, the terminal tarsal segments darkened. Wings clear yellow, veins a little darker, with brownish yellow macrotrichiae. Venation: Vein 2d A long and very strongly sinuous. Abdomen yellow. Male hypopygium (Plate 2, fig. 22) with the caudal mesal angle of each basistyle produced into a conical lobe; outer dististyle a slender black rod that tapers gradually to the acute apex; inner dististyle shorter, gently curved, beyond midlength on the outer margin with a long, erect spine; margin at apex produced into a flattened bi- or tridentate blackened blade. Gonapophyses small, relatively inconspicuous, the mesal edge blackened. Ovipositor with long, gently curved, slender valves, their margins smooth.

Habitat.—Japan (Saghalien and Hokkaido).

Holotype, male, Jozankei, August 19, 1922 (*T. Esaki*).

Allotopotype, female.

Paratype 1 male, Toyohara, Saghalien, July 13, 1922 (*T. Esaki*); 1 female, Toyohara, July 21, 1922 (*T. Esaki*); 1 female, Sapporo, Hokkaido, August 2, 1921 (*M. Hori*); 1 male, Sapporo, August 18, 1922 (*T. Esaki*); 1 female, Kamiotoineppu, August

24, 1922 (*T. Esaki*); 1 female, Abashiri, August 31, 1922 (*T. Esaki*).

This interesting species is named in honor of the collector of one of the paratype specimens, Mr. M. Hori.

Erioptera (Erioptera) orbitalis sp. nov.

General coloration reddish brown, the postnotum and pleura blue-gray pruinose; antennæ dark brown, the first flagellar segment obscure yellow; head brownish black with narrow silvery orbital lines; wings tinged with fulvous yellow.

Female, length, 5.3 millimeters; wing, 5.5.

Rostrum reddish brown, palpi dark brown. Antennæ with the scapal segments dark brown; first flagellar segment obscure yellow, the remaining segments of flagellum passing into brown. Head brownish black with a narrow silvery line adjoining the inner margin of eye, confluent on anterior part of vertex. Mesonotal prescutum reddish brown, postnotum pruinose. Pleura pale, conspicuously pale blue-gray pruinose. Halteres pale, knobs dark brown. Legs with coxæ and trochanters yellow, fore coxæ blue-gray pruinose; trochanters yellow; femora and tibiæ yellow; tarsi brownish yellow, the terminal tarsal segments passing into dark brown. Wings with a strong fulvous yellow tinge, veins darker. Venation: Vein 2d A strongly sinuous. Abdomen yellowish brown, sternites a little brighter. Ovipositor with the tergal valves long and very gently curved.

Habitat.—Japan (Hokkaido).

Holotype, female, Sapporo, August 17, 1922 (*T. Esaki*).

Erioptera (Acyphona) asymmetrica Alexander.

Erioptera asymmetrica ALEXANDER, Can. Ent. 45 (1913) 289, 290.

The following records are available in the present material: Hokkaido: Sapporo, August 17, 1922; Kamuikotan, August 22, 1922; Abashiri, August 31, 1922 (*T. Esaki*).

Erioptera (Acyphona) sachalina sp. nov.

Allied to *E. areolata* Siebke (northern Europe); general coloration pale brownish ochereous; knobs of halteres yellow; legs obscure yellow, tips of femora, tibiæ, and tarsi infuscated; male hypopygium with the intermediate chitinized lobe of dististyle simple.

Male, length, 2.6 millimeters; wing, 4 to 4.4. Female, length, 3.3 millimeters; wing, 5.5.

Rostrum and palpi dark brown. Antennæ with the basal segments light yellow, the flagellar segments beyond the basal one or two passing into light brown. Head light brown, sparsely pruinose. Mesonotum and pleura uniformly pale brownish ocherous. Halteres pale, knobs yellow. Legs with coxæ and trochanters ocherous; remainder of legs obscure yellow, tips of femora and tibiæ and the terminal tarsal segments faintly darkened. Wings with a grayish yellow tinge, base and cells C and Sc clearer yellow; veins pale brown. Venation: Cell 1st M_2 closed, very small as in the *areolata* group; basal deflection of Cu_1 slightly before fork of M; vein 2d A short and straight. Abdomen pale brownish ocherous. Male hypopygium with the ninth tergite (Plate 2, fig. 15) chitinized, the caudal margin with a broad, V-shaped notch, the lateral angles rounded; from beneath tergite on either side arises a broad plate (Plate 2, fig. 17) that is asymmetrically bifid, the mesal arm a short, blackened spine, directed mesad and nearly contiguous with its mate of the opposite side, separated therefrom by a small oval notch; the lateral arm is directed caudad into a long, blackened spine. Basistyle produced caudomesad into a long fleshy point; a single, very complex dististyle (Plate 2, fig. 19) near midlength of its mesal face, this consisting of a basal fleshy setiferous arm, and a tripartite flattened blade with the margins of all three parts chitinized, including a basal oval lobe, an intermediate simple spine, and a longer, curved, chitinized blade that runs out into a spine.

Habitat.—Japan (Saghalien).

Holotype, male, Shimizu, July 27, 1922 (*T. Esaki*).

Allotype, female, Toyohara, July 7, 1922 (*T. Esaki*).

Paratypes, 6 males and females, with the allotype, July 14 to 20, 1922 (*T. Esaki*).

Erioptera (*Acyphona*) *yezoana* sp. nov.

Male, length, about 3 millimeters; wing, 4.

Generally similar to *E. (A.) sachalina* sp. nov., differing as follows:

Antennæ longer, if bent backward extending at least to base of halteres. General coloration of head and thorax more pruinose, giving body a grayish ocherous cast. Wings with the basal section of R_2 perpendicular, subequal in length to r; cell 1st M_2 tending to be open by the atrophy of m. Male hypopygium with the lateral angles of tergite (Plate 2, fig. 16) rec-

tangular or acute; the median V-shaped notch more sinuous in outline, its point deeper; the plate arising from beneath tergite (Plate 2, fig. 18) appears as two long slender spines, directed caudad, the mesal spine about one-half the length of the lateral spine and slenderer. Dististyle (Plate 2, fig. 20) generally similar to the condition in *E. sachalina* but the basal fleshy setiferous arm is very short and stout; intermediate chitinized arm profoundly bifid; apical blade longer and slenderer.

Habitat.—Japan (Hokkaido).

Holotype, male, Shitakara, September 10, 1922 (*T. Esaki*).

Erioptera (Hoplolabis) asiatica Alexander.

Erioptera asiatica ALEXANDER, Ann. Ent. Soc. Am. 11 (1918) 447, 448.

The species had been previously known only from Honshiu. The present collection includes the following additional records:

Saghalien: Toyohara, July 17, 18, 1922 (*T. Esaki*); Hokkaido: Kamuikotan, August 17, 1922 (*T. Esaki*).

Genus ORMOSIA Rondani

Ormosia RONDANI, Dipt. Ital., Prodr. 1 (1856) 180.

Rhypholophus KOLENATI, Wien. Ent. Monatschr. 4 (1860) 393.

The extensive genus *Ormosia* is represented in the *Esaki* collection by two or three species, all but one being represented by female specimens only. As has been indicated in other papers, it is impossible to determine the female sex of many of the larger and more complex groups of crane flies.

***Ormosia subdeviata* sp. nov.**

Allied to *O. deviata* Dietz (eastern North America); general coloration brown, the prescutal stripes confluent; pleura dark; r close to fork of R_{2+3} .

Male, length, about 3.5 millimeters; wing, 4.3.

Rostrum and palpi brown. Antennæ short, brown. Head brown. Mesonotal prescutum brown, the usual stripes confluent, the humeral region surrounding the pseudosutural foveæ ocherous; scutal lobes brown; scutellum and postnotum paler brown. Pleura dark brown, sparsely pruinose, with an indistinct paler longitudinal stripe. Halteres brown, stem with golden yellow setæ. Legs with coxæ and trochanters ocherous; femora light brownish yellow, becoming a little darker toward tips; tibiæ and tarsi brown, the terminal tarsal segments dark

brown. Wings subhyaline, stigma conspicuous but ill-defined, brown; veins dark brown. Venation: r immediately beyond base of R_2 ; veins R_2 and R_3 divergent; cell 1st M_2 open by the atrophy of the outer deflection of M_3 ; basal deflection of Cu_1 at fork M; anal veins strongly divergent. Abdomen dark brown, hypopygium somewhat paler. Male hypopygium of the same general structure as in the *deviata* group, the ninth tergite (the apparent sternite) being produced caudad into a very large, sheathlike structure that is profoundly bifid. Dististyles two, the outer one a little shorter than the inner, subglabrous. Gonapophyses acicular, as in the group.

Habitat.—Japan (Saghalien).

Holotype, male, Toyohara, July 23, 1922 (*T. Esaki*).

Genus CHEILOTRICHIA Rossi

Cheilotrichia Rossi, Verz. Österreich. Dipt. (1848) 12.

It was a matter of great surprise to find in Esaki's Saghalien material a small series of the type species of this isolated monotypical genus. A critical comparison with numerous European specimens has failed to reveal any differences whatsoever.

Cheilotrichia imbuta (Meigen).

Erioptera imbuta MEIGEN, Syst. Besch. 1 (1818) 114, pl. 4, fig. 8.

The following records for this handsome little fly are included in the present collection:

Saghalien: Konuma, July 22, 1922 (on a fungus); Shimizu, July 27, 1922; Manui, August 3, 1922 (*T. Esaki*).

The collector notes that the flies swarm in the evening.

Genus HELOBIA St. Fargeau

Helobia ST. FARGEAU, Encycl. Meth., Ins. 10 (1825) 585.

Symplecta MEIGEN, Syst. Besch. 6 (1830) 282.

Helobia hybrida (Meigen).

Limnobia hybrida MEIGEN, Klass 1 (1804) 57.

A few specimens of this common and widespread species were included in the present material:

Saghalien: Toyohara, July 20, 21, 1922 (*T. Esaki*); Hokkaido: Sapporo, August 17, 1922; Jozankei, August 19, 1922; Abashiri, August 31, 1922 (*T. Esaki*).

Genus **GNOPHOMYIA** Osten Sacken

Gnophomyia OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila. (1859) 223.

The only species included in the present collection is an undescribed form that is most closely related to the Nearctic *Gnophomyia tristissima* Osten Sacken, the genotype.

Gnophomyia tristis sp. nov.

General coloration black; halteres with knobs dirty white; wings with a strong fuscous tinge; stigma elongate-oval, dark brown.

Female, length, about 8.5 millimeters; wing, 6.8.

Rostrum and palpi black. Antennæ moderately elongate, black. Head black, the anterior part of vertex faintly pruinose. Thorax entirely dull black. Halteres dark brown, knobs dirty white. Legs with coxæ and trochanters dull black; remainder of legs brownish black. Wings with a strong fuscous tinge; stigma elongate-oval, dark brown; veins brownish black. Venation: Sc_1 ending just before fork of R_{2+3} , Sc_2 far from tip of Sc_1 , the latter alone nearly as long as R_{2+3} ; r on R_2 about its own length beyond fork of R_{2+3} ; cell 1st M_2 elongate, only slightly widened distally; basal deflection of Cu_1 about one-half its length beyond fork of M . Abdomen black. Ovipositor with the valves long, the basal plate constricted.

Habitat.—Japan (Saghalien).

Holotype, female, Toyohara, July 21, 1922 (*T. Esaki*).

Genus **GONOMYIA** Meigen

Gonomyia MEIGEN, Syst. Besch. 1 (1818) 146.

Three of the four subgenera were included in the present material, these being *Gonomyia* Meigen, *Ptilostena* Bergroth, and *Lipophleps* Bergroth.

Gonomyia (*Gonomyia*) *superba* Alexander.

Gonomyia superba ALEXANDER, Can. Ent. 45 (1914) 285, 286, pl. 3, fig. 14.

Two specimens from Abashiri, Hokkaido, August 31, 1922 (*T. Esaki*), were in the present collection.

Gonomyia (*Ptilostena*) *subpruinosa* sp. nov.

General coloration ash gray, mesonotal prescutum ash gray with two intermediate pale brown stripes; pleura pale brown with an obscure yellow longitudinal stripe; wings with a yel-

lowish tinge; stigma ill defined, brown; Sc_1 extending to a short distance beyond origin of Rs; male hypopygium complex in structure.

Male, length, 4.5 millimeters; wing, 4.5 to 5. Female, length, 5 millimeters; wing, 5.5.

Rostrum and palpi dark brown. Antennæ with scape and basal segments of flagellum light yellow; remainder of flagellum dark brown. Head ash gray. Pronotum and mesonotum light ash gray, prescutum with two intermediate pale brown stripes, pseudosutural foveæ large, pale brown, reaching margin of intermediate brown stripe; humeral region and lateral margins narrowly obscure yellow; scutum ash gray, lobes slightly darkened; scutellum brown; postnotum ash gray, the posterior margin darkened. Pleura pale brown, with an obscure yellow, longitudinal stripe extending from behind fore coxæ to beneath halteres, this stripe sometimes less distinct than in the typical form. Halteres pale. Legs with coxæ and trochanters pale brown; femora and tibiæ brownish testaceous, tips slightly darkened, tarsi dark brown. Wings with a yellowish tinge; stigma subcircular in outline, brown, ill defined; veins pale brown, cord and basal deflection of Cu_1 conspicuously dark brown. Venation: Sc_1 ending a short distance beyond origin of Rs; Rs a little shorter than in *G. pruinosa* Alexander (Formosa). Abdomen dark brown, the caudal margins of segments narrowly pale yellow; sternites and hypopygium obscure yellow. Male hypopygium very complex in structure; lateral apical angle of basistyle produced caudad into a moderately elongate, fleshy lobe; mesal apical angle slightly produced; dististyles four in number, more or less connected basally; the longest style a conspicuous flattened blade, near base on the mesal face sending off a curved arm that is directed caudad, expanded into a blackened head at apex, the mesal end of head a straight spine, the lateral end a longer, strongly curved spine; the next longest style is a slender blade, the distal two-thirds blackened; at about two-thirds the length on the mesal face with a short, sharp spine, apex beyond this sinuous and gradually narrowed to the acute apex; the other styles are a short, straight, blackened spine and a somewhat longer, straight, fleshy, sparsely setiferous lobe, both of these styles directed caudad. Ædeagus fleshy, the short apical points decurved, the dorsal surface setiferous.

Habitat.—Japan (Hokkaido and Honshiu).

Holotype, male, Jozankei, Hokkaido, August 19, 1922 (T. Esaki).

Allotopotype, female.

Paratopotypes, 5 males and females; paratypes, 4 males and females, Koiwai Farm, near Morioka, northern Honshiu, August 15 to September 2, 1920 (C. Teranishi).

Gonomyia (*Ptilostena*) *sachalinensis* sp. nov.

Female, length, 5.2 millimeters; wing, 6.5.

Generally similar to *G. (P.) subpruinosa* sp. nov., differing as follows:

Size larger. Head light yellow. Pronotum yellow. Mesonotal prescutum with disk almost covered by four confluent brownish gray stripes, the humeral region and broad lateral margins of sclerites pale yellow; mediotergite of postnotum dark brown, a small area at each anterolateral angle yellow. The yellow pleural stripe broader and more distinct. Wings with stigma lacking; veins all uniformly pale brown. Venation: Sc long, Sc₁ ending opposite midlength of the long, gently arcuated Rs, Sc₂ opposite origin of Rs; R₃ long, running generally parallel to R₄₊₅, cell R₃ at wing margin less than one-half cell R₂; cell 2d M₂ deep, about twice its petiole.

Habitat.—Japan (Saghalien).

Holotype, female, Toyohara, July 24, 1922 (T. Esaki).

Gonomyia (*Lipophleps*) *flavo costalis* sp. nov.

General coloration dark brown and yellow; pleura with a longitudinal yellowish white or white stripe; wings pale brown, variegated with subhyaline, the costal margin light yellow; Sc short, cell 1st M₂ closed, basal deflection of Cu₁ at its fork.

Male, length, 3.3 millimeters; wing, 3.5. Female, length, 3.8 millimeters; wing, 3.7.

Male.—Rostrum and palpi black. Antennæ with the basal segments orange, flagellum black, segments with elongate verticils. Head yellow, center of vertex with a brown spot. Pronotum sulphur yellow. Mesonotal prescutum largely covered by three confluent grayish brown stripes, the lateral margin narrowly sulphur yellow; pseudosutural foveæ surrounded by an ochereous triangle; scutum grayish brown; scutellum and postnotum yellow, the caudal margin of the latter darkened. Pleura brown with a conspicuous, yellowish white longitudinal stripe passing beneath base of halteres; sternopleura plumb-

eous. Halteres pale, knobs sulphur yellow. Legs with fore coxæ sulphur yellow, the other coxæ ochereous yellow; trochanters ochereous; femora obscure brownish yellow with a subterminal brown ring; tibiæ and tarsi pale brown, the terminal tarsal segments darker. Wings faintly tinged with brown, handsomely variegated with subhyaline spots and blotches; cells C and Sc light yellow, more whitish basally; stigma oval, dark brown; veins dark brown; the subhyaline areas include the prearcular region; spots before and beyond stigma; a transverse band before cord, cell 1st M_2 , and smaller and more diffuse areas elsewhere on disk; veins pale brown. Venation: Sc short, Sc_1 ending a distance before origin of Rs that is nearly as long as latter; cell 1st M_2 closed; basal deflection of Cu_1 at fork of M. Abdomen dark brown, the caudal margins of segments narrowly yellow. Hypopygium obscure reddish brown, the chitinized dististyles black.

Female.—Generally similar to male, differing as follows: Lateral margins of prescutum narrower, humeral region darker. Pale pleural stripe narrower and nearly white. Halteres with face of knobs faintly darkened. Brown subterminal ring on femora darker, preceded and followed by yellowish rings. Pale rings on abdominal segments narrower and more whitish.

Habitat.—Japan (Hokkaido).

Holotype, male, Jozankei, August 19, 1922 (*T. Esaki*).

Allotopotype, female.

Paratypes, 1 female, Kutchan, July 9, 1922 (*T. Esaki*), at light of train; 1 female, Shikaripetsu, August 26, 1922 (*T. Esaki*).

Genus *PARATROPESA* Schiner

Paratropesa SCHINER, Verh. Zool. bot. Ges. Wien 16 (1866) 932.

The restricted genus *Paratropesa* now includes seven species, all from Tropical America. It was a great surprise to find in the present collection a perfectly typical member of this otherwise characteristically Neotropical group.

Paratropesa esakii sp. nov.

General coloration shiny black and yellow; rostrum nearly as long as head; halteres black, knobs orange yellow; femora yellow, the enlarged tips black; wings faintly tinged with yellow, sparsely variegated with brown.

Male, length, 6 millimeters; wing, 7.5. Female, length, 6.5 millimeters; wing, 6.

Rostrum nearly as long as head, black; palpi black. Antennæ dark brown; second scapal segment and base of first flagellar segment obscure yellow or yellowish brown. Head black, the anterior part of vertex sparsely pruinose; front yellow. Pronotum shiny yellow, narrowly darkened medially. Mesonotal prescutum shiny yellow, with three confluent, shiny black stripes that cover the entire sclerite except a small median area at suture, conspicuous triangular humeral areas and small spots at lateral ends of suture; scutum light yellow, each lobe almost covered by a shiny black area that is confluent with the prescutal marking; median sclerite of scutellum yellow; postnotum black. Pleura yellow; a conspicuous circular black spot on the dorsal pleurites ventro-cephalad of wing root; sternopleura faintly darkened. Halteres black, knobs conspicuously orange yellow. Legs with coxæ and trochanters yellow; femora obscure yellow, tips swollen and extensively blackened, these broadest on fore femora where about two-fifths of segment is included, narrowest on the posterior femora where the distal fifth is blackened; tibiæ brownish yellow, base narrowly, tip more broadly blackened; metatarsi black, base paler; remainder of tarsi black. Wings faintly tinged with yellow, base brighter; stigma small, suboval, dark brown; narrow brown seams at Sc_2 , along cord and outer end of cell 1st M_2 , along R_2 , at tips of longitudinal veins and at apex of wing; veins black. Venation: Sc_1 ending nearly opposite midlength of R_s , Sc_2 a short distance beyond origin of R_s ; R_2 about one-third R_3 ; cell 1st M_2 elongate, gently widened distally; basal deflection of Cu_1 about one-half its length beyond fork of M . Abdomen black, the incisures of tergites yellow, this including the extreme base and apex of each segment; hypopygium black; sternum yellow, sternites 2 to 4 with a blackish subterminal ring; segment 5 black, hairy as in this group. In female, abdomen black, the caudal margins of segments narrowly yellow; tergal valves of ovipositor obscure orange.

Habitat.—Japan (Hokkaido).

Holotype, male, Maruyama, August 17, 1922 (*T. Esaki*).

Allotype, female, Jozankei, August 19, 1922 (*T. Esaki*).

Paratopotypes, 3 males; paratype, 1 male, Abashiri, August 31, 1922 (*T. Esaki*).

The discovery of a species of *Paratropesa* in Japan is of exceptional interest. The present species is a true *Paratropesa*,

the other Old World species hitherto placed in this genus being more correctly referable to *Gymnastes* Brunetti. This handsome little fly is named in honor of the collector, Dr. Teiso Esaki, who has done much toward making known the interesting tipulid fauna of Japan.

Genus **TEUCHOLABIS** Osten Sacken

Teucholabis OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila. (1859) 222.

The genus *Teucholabis* includes more than fifty species, the great majority of which are from Tropical America. A few species occur in the Old World, mostly in the Oriental Region. The present species, *Teucholabis yezoensis* sp. nov., is the most northerly species so far discovered, with the possible exception of the Nearctic *T. complexa* Osten Sacken.

Teucholabis yezoensis sp. nov.

General coloration shiny yellow and black; halteres with knobs orange yellow; legs black, the femoral bases yellow; wings subhyaline, stigma small, oval, brown; cell 1st M_2 long and narrow.

Male, length, 7 millimeters; wing, 6.2 to 6.4. Female, length, 8.2 millimeters; wing, 6.3 to 6.4.

Rostrum about as long as head, black; palpi black. Antennæ black, the basal segments paler. Head black, sparsely pruinose anteriorly. Pronotum shiny yellow, indistinctly darkened medially. Mesonotal prescutum shiny yellow with three confluent shiny black stripes that cover the entire sclerite excepting a small median area at suture, the lateral ends of suture, and larger, triangular humeral areas; scutum yellow, the lateral margins of lobes shiny black; scutellum honey yellow; postnotum black. Pleura yellow; a small and indistinct shiny black area on the dorsopleural region immediately cephalad of the lateral ends of suture. Halteres black, knobs orange yellow. Legs with coxæ and trochanters yellow, femora black, bases broadly and conspicuously yellow, narrowest on forelegs where a little less than one-half of the segment is included, broadest on hind legs where about two-thirds of segment is included; tibiæ pale brown, blackish at base and apex; basitarsi brown, tips and remainder of tarsi black. Wings subhyaline; stigma small, oval, brown; veins dark brown. Venation: Sc_1 ending before or near midlength of R_s ; Sc_2 a short distance beyond origin of R_s ; r about its own length from

tip of R_1 and a short distance beyond fork of R_s ; cell 1st M_2 long and narrow, gently widened distally, a little longer than vein M_3 beyond it; basal deflection of Cu_1 about one-half to one-third its length beyond fork of M . Abdomen black, incisures of tergites rather broadly yellowish; sternites yellow, faintly darkened laterally; the fifth sternite black and hairy; hypopygium brownish black.

Habitat.—Japan (Hokkaido).

Holotype, male, Shikaripetsu, August 26, 1922 (*T. Esaki*).

Allotopotype, female.

Paratopotypes, 1 male and 1 female.

Teucholabis yezoensis bears a striking superficial resemblance to *Paratropesa esakii* sp. nov.

Genus NEOLIMNOPHILA Alexander

Neolimnophila ALEXANDER, Proc. Calif. Acad. Sci. (4) 10 (1920) 37, 38.

The genus *Neolimnophila* was erected for the supposed Hexatomine *Limnophila ultima* Osten Sacken. Recent studies on the tribe Claduraria have indicated that the present group is more properly referable to the Eriopterini than to the Hexatomini, and that the closest relative of the present group is *Crypteria* Bergroth.

Neolimnophila ultima (Osten Sacken) var.

Limnophila ultima OSTEN SACKEN, Proc. Acad. Nat. Sci. Phila. (1859) 238, pl. 4, fig. 26.

Two females, from Toyohara, Saghalien, July 17, 1922 (*T. Esaki*), are referred to this Nearctic species, as a variety.

Genus CONOSIA van der Wulp

Conosia VAN DER WULP, Tijdsch. v. Ent. 23 (1880) 159.

The genotype *Conosia irrorata* (Wiedemann) has a vast range over the tropical and subtropical regions of the Old World. In the present collection it is represented by material from Hokkaido, which seems to be the most northern station so far discovered.

Conosia irrorata (Wiedeman).

Limnobia irrorata WIEDEMANN, Aussereur. zweifl. Ins. 1 (1828) 574.

One female from Kamuikotan, Hokkaido, August 22, 1922 (*T. Esaki*).

Subfamily CYLINDROTOMINÆ

Genus CYLINDROTOMA Macquart

Cylindrotoma MACQUART, Hist. Nat. Ins., Dipt. (1834) 107.

Cylindrotoma japonica Alexander.

Cylindrotoma japonica ALEXANDER, Ann. Ent. Soc. Am. 12 (1919) 344, 345.

This was the only member of the subfamily taken by Doctor Esaki upon his northern trip. The fly was known hitherto only from Honshiu. The following additional records are available:

Saghalien: Takinosawa, July 26, 1922; Shimizu, July 27, 1922. Hokkaido: Kamiotoineppu, August 24, 1922; Shikaripetsu, August 26, 1922; Akan, September 3, 1922.

Genus NESOPEZA Alexander

Nesopeza ALEXANDER, Can. Ent. 46 (1914) 157.

Nesopeza geniculata Alexander.

Nesopeza geniculata ALEXANDER, Ann. Ent. Soc. Am. 11 (1918) 448, 449.

One male, Abashiri, Hokkaido, August 30, 1922 (*T. Esaki*). The species had been recorded from Honshiu and Kiushiu.

Genus OROPEZA Needham

Oropeza NEEDHAM, 23d Rept. N. Y. St. Ent. for 1907 (1908) 211.

The genus *Oropeza* furnishes a strong point of evidence regarding the close relationship existing between the fauna and flora of Japan and those of eastern North America, well shown in many groups of animals and plants. The genus, as at present known, includes eight American species, all from the eastern United States and Canada, and three additional species from Japan, one occurring in Formosa.

Oropeza satsuma Alexander.

Oropeza satsuma ALEXANDER, Journ. N. Y. Ent. Soc. 26 (1918) 67.

Saghalien: Toyohara, July 16, 1922 (*T. Esaki*). Hokkaido: Sapporo, August 21, 1922; Kamiotoineppu, August 23, 1922 (*T. Esaki*).

Genus TANYPTERA Latreille

Tanyptera LATREILLE, Hist. Nat. Crust. et Ins. 14 (1805) 286.

Xiphura BRULLE, Ann. Soc. Ent. France 1 (1832) 206.

Tanyptera jozana (Matsumura) var.

Xiphura jozana MATSUMURA, Thous. Ins. Japan, Add. 2 (1916) 450, 451, pl. 24, fig. 13.

Saghalien: Toyohara, July 13 to 16, 1922 (*T. Esaki*); Kohnuma, July 22, 1922 (*T. Esaki*).

The typical variety was described from Hokkaido, and is now known also from Honshu. The present form is presumably the one recorded by Matsumura from Solowiyofka, Saghalien (1911: 62) under the name *Xiphura macra* Loew, which is now considered a synonym of *Tanyptera gracilis* (Portschinsky).

Genus CTENOPHORA Meigen

Ctenophora MEIGEN, Illiger's Mag. 2 (1803) 263.

Ctenophora biguttata Matsumura.

Ctenophora biguttata MATSUMURA, Thous. Ins. Japan, Add. 2 (1916) 454, 455, pl. 24, fig. 16.

One female, Manui, Saghalien, August 3, 1922 (*T. Esaki*).

Known hitherto only from the vicinity of Sapporo (the type locality) and from northern Teshio, Hokkaido.

Genus NEPHROTOMA Meigen

Nephrotoma MEIGEN, Illiger's Mag. 2 (1803) 262.

Pachyrrhina MACQUART, Hist. Nat. Ins., Dipt. 1 (1834) 88.

The genus *Nephrotoma* is abundantly represented in all parts of the Japanese Empire. The present collection included eight species.

Nephrotoma esakii sp. nov.

General coloration shiny black; head orange above; knobs of halteres sulphur yellow; legs with fore femora largely black; tibiae yellow, tips narrowly dark brown; wings with a yellowish tinge, apex narrowly seamed with brown; valves of ovipositor orange, relatively short and small.

Female, length, about 10 millimeters; wing, 12.

Frontal prolongation of head, palpi, and mouth parts black. Antennae with scape and basal segment of flagellum orange yellow; intermediate flagellar segments with bases paler than apices; terminal segments of antennae dark brown. Head orange yellow, the occipital band shiny black; genae and beneath dull black. Pronotum black. Mesonotal prescutum shiny black, the usual interspaces very narrowly yellow, these capillary lines attaining suture but not reaching the anterior end of sclerite; scutum yellow, lobes largely black; scutellum and

postnotum black. Pleura black, the dorsopleural membrane buffy; a very obscure, paler brown area before root of halteres. Halteres brown, the knobs conspicuously sulphur yellow. Legs with coxæ black; trochanters yellow; femora yellow, tips broadly blackened, fore femora black with the exception of narrow, obscure yellow bases; tibiæ abruptly yellow, tips narrowly dark brownish black; basitarsi brownish yellow, passing into black; remainder of tarsi black. Wings strongly tinged with yellow, base and cells C and Sc more saturated yellow; stigma oval, pale brown; wing apex very narrowly margined with dark brown; veins dark brown, very narrowly seamed with brown. Venation: Rs only a little longer than the basal deflection of R_{4+5} ; cell M_1 rather broadly sessile; fusion of Cu_1 and M rather extensive, ending at fork of M. Abdomen black, the intermediate segments with a large, obscure yellow area on either side of the capillary median black stripe; segments 5 to 8 shiny black. Ovipositor with the valves relatively short and small, obscure orange. The somewhat similar *Nephrotoma stygia* Alexander has the valves of the ovipositor of normal length.

Habitat.—Japan (Hokkaido).

Holotype, female, Kamiotoineppu, August 25, 1922 (T. Esaki).

This handsome species is named in honor of the collector, Dr. Teiso Esaki, to whom we are indebted for almost our sole knowledge of the tipulid fauna of northern Hokkaido and Saghalien.

Nephrotoma dorsalis sachalina subsp. nov.

Male, length, about 11 millimeters; wing, 12.8 to 13.

Generally similar to *N. dorsalis* Meigen (Europe), differing as follows:

Lateral margins of pronotal scutum conspicuously blackened. Femoral apices more extensively infuscated. Brown cloud on basal deflection of R_{4+5} and r-m more extensive. Male hypopygium largely black instead of obscure brownish yellow; outer dististyle near midlength produced into a very slender, attenuate point, slenderer than in typical *dorsalis*.

Habitat.—Japan (Saghalien).

Holotype, male, Toyohara, July 16, 1922 (T. Esaki).

Paratopotype, male.

Nephrotoma hirsuticauda sp. nov.

General coloration orange, prescutum and scutum with black stripes; wings tinged with pale yellow, base and cell Sc brighter

yellow; abdomen orange, the lateral margins of tergites interruptedly darkened; eighth sternite of male hypopygium large, deeply incised medially, incision clothed with dense, long, yellow setae.

Male, length, 10 millimeters; wing, 9 to 9.2. Female, length, 13 millimeters; wing, 11.4.

Frontal prolongation of head obscure yellow, nasus darker; mouth parts and palpi pale brown. Antennæ rather short, if bent backward not extending far beyond root of wing; basal three segments obscure orange, remainder of organ black. Head orange, the occipital band conspicuous, brown. Pronotum obscure yellow. Mesonotal prescutum shiny yellow with three black stripes; in the type, these stripes are much paler, except at the anterior ends; lateral stripes very strongly and conspicuously outcurved, scutal lobes conspicuously marked with black, in the type with only the ends of these marks blackened; scutellum orange testaceous; postnotum orange. Pleura obscure orange, indistinctly variegated with obscure yellow, this including a conspicuous mark between bases of wings and halteres. Halteres pale brown, apices of knobs yellow. Legs with coxæ and trochanters obscure yellow; femora and tibiæ pale brown, tips narrowly blackened; tarsi brownish black. Wings tinged with pale yellow, base and cell Sc brighter yellow; stigma small, pale brown; veins dark brown. Venation: Rs short, in alignment with deflection of R_{4+5} , shorter than R_{2+3} ; r-m short; cell M_1 narrowly sessile. Abdomen orange, the lateral margins of tergites with brown markings, more or less interrupted at base of segments; in the Mount Moiwa paratype, this coloration extends across the caudal margin of tergite 7; hypopygium orange. Male hypopygium obliquely truncated, the ventral surface of the extensive eighth sternite with conspicuous long yellow setae, these decussate across a deep median incision; lobes of ninth sternite likewise with shorter but conspicuous yellow setae.

Habitat.—Japan (Saghalien and Hokkaido).

Holotype, male, Sapporo, Hokkaido, July, 1921 (*S. Kuwayama*).

Allotype, female, Toyohara, Saghalien, July 20, 1922 (*T. Esaki*).

Paratypes, 1 male, Mount Moiwa, near Sapporo, Hokkaido, July 15, 1921 (*M. Hori*); 3 males and females, with the allotype, July 20 to 23, 1922 (*T. Esaki*).

Nephrotoma hirsuticauda somewhat resembles *N. geminata* Alexander (Honshiu), differing in the coloration and structure of the male hypopygium.

Nephrotoma minuticornis Alexander.

Nephrotoma minuticornis ALEXANDER, Ann. Ent. Soc. Am. 14 (1921) 134.

The type locality is Sapporo. The present collection includes the following material.

Saghalien: Toyohara, July 16, 1922 (*T. Esaki*). Hokkaido: Sapporo, August 17, 1922; Jozankei, August 19, 1922; Kamui-kotan, August 22, 1922; Kamiotoineppu, August 24, 1922; Kamiokoppe, August 27, 1922; Setoughi, August 28, 1922; Abashiri, August 31, 1922; Tsubetsu, September 1, 1922; Ponkikin, September 2, 1922 (*T. Esaki*).

Nephrotoma aculeata atricauda subsp. nov.

Male, length, 12 millimeters; wing, 13. Female, length, 14 millimeters; wing, 13.5.

Generally similar to typical *aculeata* (Loew) of Europe, differing as follows: Body heavier, including hypopygium. Male hypopygium shiny black, appendages larger and more prominent. Aculeate spine on eighth sternite stouter and more strongly curved.

Habitat.—Japan (Saghalien).

Holotype, male, Toyohara, August 8, 1922 (*T. Esaki*).

Allotopotype, female.

Paratopotype, male.

Nephrotoma cornicina (Linnæus) var.

Tipula cornicina LINNÆUS, Syst. Nat., ed. 10 (1758) 586.

This species had already been recorded from Honshiu. Doctor Esaki's material adds the following records of distribution:

Saghalien: Maoka, July 29, 1922 (*T. Esaki*). Hokkaido: Sapporo, July 10 to August 16, 1922; Jozankei, August 19, 1922; Kamiotoineppu, August 24, 1922; Abashiri, August 31, 1922 (*T. Esaki*).

Nephrotoma lamellata (Riedel) var.

I can detect no essential differences between the Japanese specimens and Riedel's description of this European species. The present collection includes the following records:

Saghalien: Shimizu, July 27, 1922; Maoka, July 28; 1922; Todorokitôge, August 2, 1922 (*T. Esaki*).

Nephrotoma parvirostra sp. nov.

General coloration yellow; occipital band very small to subobsolete; lateral ends of transverse suture blackened; abdomen orange, tergites with an interrupted median stripe; eighth sternite of male hypopygium with a small, prow-shaped median lobe.

Male, length, 11 to 11.5 millimeters; wing, 11 to 11.5.

Frontal prolongation of head yellow, the elongate nasus brown; palpi pale brown, the terminal segment yellow, narrowly tipped with brown. Antennæ rather short, if bent backward extending to beyond wing root; first scapal segment bright yellow; segments 2 and 3 light brown; remaining segments dark brownish black, covered with a dense microscopic pubescence. Head orange, the vertical tubercle light sulphur yellow; occipital band very small to subobsolete, pale brown, the anterior end truncate. Pronotum sulphur yellow. Mesonotum light yellow, prescutum with three black stripes, the lateral stripes with a dark spot at their anterior ends, producing the appearance of being outcurved; scutal lobes similar, very extensively marked with black, the color following along suture to wing root; scutellum pale brownish testaceous; postnotum whitish yellow, the caudal margin of the median sclerite with two pale brown areas. Pleura pale reddish brown, variegated with pale yellow, the latter color including a conspicuous area on the lateral sclerites of postnotum between bases of wings and halteres. Halteres pale brown, base of stem and knobs yellow. Legs with coxæ and trochanters yellow; femora pale brown; tibiæ pale brown, narrowly tipped with dark brown; tarsi dark brown. Wings with a pale brown tinge; stigma rather light brown; a very indistinct seam along the basal deflection of R_{4+5} and r-m; veins dark brownish black. Venation: Cell M_1 subsessile or very short-petiolate. Abdomen obscure orange, tergites with a median series of black areas on the posterior half of tergites 2 to 6; tergite 7 more extensively blackened; tergites 8 and 9 and hypopygium orange; eighth sternite black on basal half. Male hypopygium with the median portion of the caudal margin of the eighth sternite produced into a small, prow-shaped lobe, this very compressed and covered with an appressed yellow pubescence, directed caudad, tip ventrad.

Habitat.—Japan (Hokkaido).

Holotype, male, Sapporo (M. Hori).

Paratopotype, male, July 25, 1921 (*S. Kuwayama*); paratypes, male, Shikaripetsu, August 26, 1922 (*T. Esaki*); male, Kamiokoppe, August 27, 1922 (*T. Esaki*).

Genus TIPULA Linnæus

Tipula LINNÆUS, Syst. Nat. ed. 10 (1758) 585.

Nippotipula MATSUMURA, Thous. Ins. Japan, Add. 2 (1916) 457, 458.

Platytipula MATSUMURA, Thous. Ins. Japan, Add. 2 (1916) 459.

Yamatotipula MATSUMURA, Thous. Ins. Japan, Add. 2 (1916) 461, 462.

Togotipula MATSUMURA, Thous. Ins. Japan, Add. 2 (1916) 465.

The great genus *Tipula* is abundantly represented in the Japanese Empire. The present collection included representatives of eighteen species, seven of which are considered as being undescribed.

Tipula coquilletti Enderlein.

Tipula nubifera COQUILLET, Proc. U. S. Nat. Mus. 21 (1898) 305; preoccupied by *Tipula nubifera* van der Wulp (1881).

Tipula coquilletti ENDERLEIN, Zool. Jahrb., Syst. 32 (1912) 7.

This is the largest and handsomest species of the genus in Japan. It ranges from Saghalien southward to the mountains of Taiwan. The Esaki material includes the following:

Saghalien: Kiminai, August 12, 1922. Hokkaido: Kamiokoppe, August 27, 1922; Panketo, September 6, 1922; Maruyama, September 17, 1922.

Tipula moiwana (Matsumura).

Platytipula moiwana MATSUMURA, Thous. Ins. Japan, Add. 2 (1916) 458, 459, pl. 25, fig. 2.

This beautiful late summer and autumnal species bears a resemblance to the Nearctic *T. ultima* Alexander. It was described from Mount Moiwa and other stations near Sapporo. Doctor Esaki's collections include the following records:

Hokkaido: Kamiotoineppu, August 25, 1922; Shikaripetsu, August 26, 1922; Kamiokoppe, August 27, 1922; Abashiri, August 31, 1922; Akan, September 4 to 7, 1922; Sapporo, September 26, 1922.

Tipula nova Walker.

Tipula nova WALKER, List Dipt. Brit. Mus. 1 (1848) 71.

Yamatotipula nohirae MATSUMURA, Thous. Ins. Japan, Add. 2 (1916) 461, pl. 25, fig. 4.

This species has a very wide range over eastern and southern Asia. Doctor Esaki secured the species in two places in

Hokkaido: Kamiotoineppu, August 25, 1922; Shitakara, September 10, 1922.

Tipula variicornis Schummel.

Tipula variicornis SCHUMMEL, Beitr. zur Entomol. 3 (1833) 99, pl. 3, figs. 2, 3.

Tipula annulicornis MEIGEN, Syst. Besch. 6 (1830) 289, pl. 65, fig. 9; preoccupied by *T. annulicornis* Say (1829).

This familiar European species was taken by Doctor Esaki at Toyohara, Saghalien, July 13 to 21, 1922. It had previously been recorded from Tonnaitcha, Saghalien, by Matsumura (1911) under the name *Pachyrrhina annulicornis* Meigen.

Tipula latemarginata Alexander.

Tipula latemarginata ALEXANDER, Ann. Ent. Soc. Am. 14 (1921) 128, 129.

This species is related to *T. marginata* Meigen of Europe. Some of the Hokkaido specimens recorded below are larger and with a heavier wing pattern than in typical examples, but undoubtedly belong here. The following material was secured by Doctor Esaki:

Saghalien: Konuma, July 17, 1922; Toyohara, July 25, 1922; Takinosawa, July 26, 1922; Shimizu, July 27, 1922; Manui, August 3, 1922; Odasam, August 5, 1922; Kiminai, August 12, 1922. Hokkaido: Maruyama, August 17, 1922; Jozankei, August 19, 1922; Kamuikotan, August 23, 1922; Kamiotoineppu, August 24, 1922; Shikaripetsu, August 26, 1922; Abashiri, August 31, 1922; Ponkin, September 2, 1922.

Tipula fumida sp. nov.

General coloration gray, prescutum with three dark brown stripes; wings strongly tinged with brown, with oblitative areas before stigma and across base of cell 1st M_2 ; male hypopygium with the caudal margin of the ninth tergite produced into a blunt median lobe, apex of which is blackened and feebly bilobed.

Male, length, 12 millimeters; wing, 14.5.

Frontal prolongation of head obscure brownish yellow, light gray above; nasus elongate; palpi brownish black. Antennæ rather short, scape and two basal segments of flagellum brown, the terminal flagellar segments darker brown to almost black. Head dark gray, the median area darker. Pronotum dark gray, the scutellar angles light yellow. Mesonotal prescutum gray

with three dark brown stripes, the median stripe split by a capillary dark brown vitta; scutellum and postnotum dark brownish gray. Pleura gray, darker on the anterior pleurites; dorsopleural membrane buffy. Halteres light brown. Legs with coxæ pale; trochanters obscure yellow; femora and tibiæ brownish yellow, tips narrowly but conspicuously blackened, this amount subequal on all legs; tarsi black, basitarsi paler proximally. Wings strongly tinged with brown, base more yellowish; stigma slightly darker brown; conspicuous oblitative areas before stigma and across base of cell 1st M_2 ; veins dark brown. Venation: Rs long, more than twice R_{2+3} ; R_2 entire; r relatively short; cell 1st M_2 gently narrowed distally; petiole of cell M_1 longer than m; m-cu at about one-fifth the length of cell 1st M_2 ; cell 2d A relatively narrow. Abdominal tergites obscure yellow, on either side with a broad, conspicuous, dark stripe, the lateral margins and median area broadly of ground color; caudal margins of segments narrowly pale; sternites dark brown, the terminal segments more pruinose; caudal margins of sternites narrowly ringed with pale; hypopygium rather pale. Male hypopygium with the caudal margin of the ninth tergite produced into a median lobe as in *T. latemarginata* Alexander and allies, apex feebly bilobed, blackened. Outer dististyle a pale, flattened lobe. Eighth sternite unarmed.

Habitat.—Japan (Hokkaido).

Holotype, male, Kushiro, September 11, 1922 (*T. Esaki*).

Tipula bipenicillata sp. nov.

Male, length, 16 to 17 millimeters; wing, 17 to 18. Female, length, 22 millimeters; wing, 18.

Rather closely resembling *T. saitamæ* Alexander, differing in the details of coloration and the structure of the male hypopygium.

Femoral tips conspicuously and broadly dark brown; tibial apices extensively blackened. Wings more grayish; cell Sc and stigma infuscated; oblitative areas passing from cell 1st R_1 before stigma into cell 1st M_2 . Abdomen with segments 6 to 9 black, the caudal margins of segments narrow, the lateral margins of tergites more broadly pale. Male hypopygium with the caudal margin of the eighth sternite unarmed except for a conspicuous pencil or rather short golden setæ on either side.

Habitat.—Japan (Saghalien).

Holotype, male, Toyohara, July 23, 1922 (*T. Esaki*).

Allotype, female, Konuma, July 21, 1922 (*T. Esaki*).

Paratopotype, male, July 25, 1922; paratypes, 2 males, with the allotype; 1 male, Shimizu, July 27, 1922 (*T. Esaki*).

Tipula saitamæ Alexander.

Tipula saitamæ ALEXANDER, Trans. Amer. Ent. Soc. 46 (1920) 21, 22.

One male, Abashiri, Hokkaido, August 30, 1922 (*T. Esaki*).

Tipula insulicola fuscicauda subsp. nov.

Male, length, 10 millimeters; wing, 12.5. Female, length, 11 to 12 millimeters; wing, 11.5 to 12.

Close to the typical subspecies, differing in the larger and stouter hypopygium of the male which is conspicuously brownish black, the longer median process of the ninth tergite yellow. Wing membrane more grayish yellow.

Habitat.—Japan (Saghalien).

Holotype, male, Manui, August 3, 1922 (*T. Esaki*).

Allotopotype, female.

Paratypes, 1 male, Toyohara, July 21, 1922 (*T. Esaki*), at honey bait trap; 2 females, July 25, 1922 (*T. Esaki*).

Tipula nipponensis Alexander.

Tipula nipponensis ALEXANDER, Can. Ent. 46 (1914) 236, 237.

Saghalien: Toyohara, July 21, 1922, at honey bait trap; Konuma, July 21, 1922; Takinosawa, July 26, 1922; Nodasam, July 30, 1922 (*T. Esaki*). Hokkaido: Kamiotoineppu, August 23, 24, 1922 (*T. Esaki*).

The radial sector is shorter than in the type but the species is almost certainly identical.

Tipula westwoodiana sp. nov.

Size large (wing, over 25 millimeters); general coloration gray, prescutum with four brown stripes; wings with a strong yellowish tinge, base and cells C and Sc more saturated; stigma brown; abdominal tergites obscure yellow with two sublateral brown stripes on either side.

Female (?), length of wing, 26.8 millimeters.

Frontal prolongation of head dark; nasus elongate; palpi with basal two segments black, the terminal two yellow, with the extreme tip of the last darkened. Antennæ with the scape yellow, the flagellar segments brown. Head dark, sparsely pruinose; vertex flattened, the usual tubercle represented only by a tiny protuberence behind each antennal fossa. Mesonotal prescutum dull gray with four brown stripes; humeral triangle

reddish brown; scutum light gray, each lobe with a circular brown mark; scutellum with the median lobe dark, dusted with gray, the lateral lobes variegated with pale; postnotum with mediotergite black, dusted with gray. Pleura dark brown, discolored in type, presumably gray pruinose in fresh specimens; pleurotergite with a yellowish semicircle surrounding root of halteres. Halteres brownish yellow. Legs with coxæ dark, presumably pruinose in fresh specimens, apices paler; trochanters obscure yellow; femora obscure yellow basally, tips conspicuously blackened, on forelegs including the distal two-thirds, on the posterior femora only the broad tips are blackened; tibiæ brown, tips darker; tarsi brownish black. Wings with a strong yellowish tinge, base and cells C and Sc saturated; stigma oval, brown; brown seams along cord and more narrowly on the longitudinal veins beyond cord; veins black, paler in the flavous areas. Venation: Rs long; R_2 distinct for its entire length; r with macrotrichiae throughout its length; petiole of cell M_1 about one-half m; m-cu short but distinct. Abdominal tergites obscure yellow, the lateral margins buffy, margined internally by a more or less distinct brown stripe; median line of tergite broadly obscure yellow, bordered on either side by a broad, sublateral, dark brown stripe; on the subterminal segments the dark stripes become confluent; sternites brownish yellow; tip of abdomen broken in the unique type.

Habitat.—Japan (Saghalien).

Holotype, sex ?, Shimizu, July 27, 1922 (T. Esaki).

Tipula coquilletiana sp. nov.

Belongs to the *centralis* group; male hypopygium with the ninth tergite rather narrow, the caudal margin elevated into a narrow, erect, chitinized rim that is feebly denticulate.

Male, length, 16 millimeters; wing, 18.

Frontal prolongation of head reddish brown, gray above; nasus elongate; palpi black. Antennæ relatively short; scape obscure yellow, the first segment a little darkened basally; flagellum dark brown, the basal swellings moderate in size. Head gray, clearer posteriorly. Mesonotal prescutum light gray with four darker gray stripes, each of which is narrowly bordered by brown; scutum light gray, lobes largely dark gray; scutellum and postnotum light gray. Pleura gray; dorsopleural membrane buffy. Halteres obscure brownish yellow, knobs dark brown. Legs with coxæ gray; trochanters obscure yellow; femora brownish yellow, tips broadly dark brown; tibiæ brown, tips

very indistinctly darker; tarsi brown, the terminal segments passing into dark brown. Wings of the general type of *T. kuwayamai* Alexander and related species; whitish subhyaline, base and costal region more yellowish; stigma small, preceded by an eyelike brown spot; pale brown clouds on surface, the white pattern correspondingly restricted, including a narrow band beyond the cord extending through cell 1st M_2 into M_3 ; bases of cells R and M; a large blotch near two-thirds the length of cell M; and base and apex of cell 1st A; outer end of cell R_5 pale; bases of cells R and M not darkened; veins dark brown. Abdomen with the basal segment pruinose; segment 2 yellow, the lateral margins ochreous, sparsely pruinose; tergites 3 to 5 similar but becoming gradually darker colored; terminal segments and hypopygium dark brown, segments very narrowly ringed caudally with pale. Male hypopygium of the general type of *T. centralis* and related species. Ninth tergite rather narrow, the caudal margin elevated into a narrow, erect, chitinized rim, shiny black, the caudal margin nearly straight across but feebly denticulate, the lateral angles a little more conspicuous. Outer dististyle slender, clavate. Eighth sternite unarmed.

Habitat.—Japan (Saghalien).

Holotype, male, Odasam, August 5, 1922 (*T. Esaki*).

Paratopotype, male.

Tipula verecunda sp. nov.

Male, length, 13 to 14 millimeters; wing, 17. Female, length, 20 to 22 millimeters; wing, 17 to 19.

Generally similar to *T. coquillettiana* sp. nov., differing as follows:

Antennæ longer. Head light ochreous yellow with a capillary brown median vitta. Mesonotal prescutum paler with the four stripes darker brownish gray, narrowly and conspicuously margined with dark brown, the lateral stripes crossing suture onto the anterolateral regions of scutum; disk of scutal lobes with a larger brownish gray area, narrowly margined with darker; scutellum and postnotum gray with a narrow, dark brown, median line. Pleura dark gray, the dorsopleural membrane more buffy. Wings somewhat similar to *T. coquillettiana*, differing chiefly as follows: Bases of cells R and M darkened; the white band before midlength of cell 1st A continued across vein 1st A to wing margin in tip of cell 2d A; bases of anal cells more abruptly pale. Venation: Cell 1st M_2 smaller. Abdomen with tergites 2 to 4 light yellow, the lateral margins

broadly pale, narrowly margined internally by a brownish black line; terminal segments uniformly dark brownish black with pale margins; sternites similar, the terminal segments dark pruinose. Male hypopygium with the ninth tergite extensive but not chitinized, the caudal margin with a deep U-shaped notch, surface with yellow setæ. Basistyle complete. Outer dististyle flattened, dark-colored. Ninth sternite produced ventrad into a small median tubercle. Eighth sternite unarmed caudally but surface with rather numerous long yellow setæ. Female with the valves of the type of *T. arctica* et al., but margins not serrate.

Habitat.—Japan (Saghalien).

Holotype, male, Toyohara, July 16, 1922 (*T. Esaki*).

Allotype, female, Shimizu, July 27, 1922 (*T. Esaki*).

Paratopotypes, 3 males and 1 female, July 13, 14, 1922; paratype, female, Nodasam, July 31, 1922.

Tipula tantula sp. nov.

General coloration gray, prescutum with four very indistinct darker gray stripes; femora brownish yellow, tips blackened; wings subhyaline, with a very pale, ill-defined brown pattern; male hypopygium with the ninth tergite having a V-shaped notch.

Male, length, 10.5 millimeters; wing, 11.

Frontal prolongation of head dark gray above, nasus apparently lacking or very rudimentary; palpi relatively short, black. Antennæ relatively short; scape and first flagellar segment obscure yellow; remainder of antenna dark brown; individual flagellar segments moderately incised. Head dull gray, with a capillary dark brown vitta. Mesonotal prescutum gray with four very indistinct darker gray stripes, the intermediate pair only narrowly separated from one another, strongly narrowed behind; scutum dark gray, centers of lobes faintly darkened; scutellum light gray with a capillary brown median vitta; postnotum gray with a capillary brown line. Pleura gray, indistinctly variegated with darker; dorsopleural membrane buffy. Halteres pale brownish white. Legs with coxæ light gray, paler apically; trochanters yellow; femora brownish yellow, tips narrowly but conspicuously blackened, the amount subequal on all the legs; tibiæ paler brown, tips very narrowly darker brown; tarsi black. Wings subhyaline, with a very pale brown, ill-defined pattern; stigma oval, darker brown; the subhyaline markings include areas before and beyond

stigma, the latter forming an ill-defined crossband that follows through cell 1st M_2 into base of cell M_3 ; a blotch beyond mid-length of cell M ; a pale area in cell 1st A at tip of vein 2d A ; less-distinct pale areas in the anal and cubital cells near base; veins brown. Venation: R_s very long; base of R_2 faintly indicated, perpendicular at origin; basal deflection of R_{4+5} short or lacking; cell 1st M_2 nearly pentagonal; petiole of cell M_1 more than twice m ; $m-cu$ obliterated by fusion of adjoining veins. Abdomen obscure yellow, the lateral margins of tergites narrowly buffy, margined internally by a narrow black line; segments 5 to 9 passing into black; sternites similar. Male hypopygium moderately incrassate. Ninth tergite with a broad V-shaped notch, at base of which is a microscopic tubercle. Outer dististyle slender, pale; inner dististyle a conspicuous compressed blade, the apical point jutting into notch of tergite. Ninth sternite with a deep V-shaped median notch. Eighth sternite unarmed.

Habitat.—Japan (Saghalien).

Holotype, male, Odasam, August 5, 1922 (*T. Esaki*).

Tipula matsumuriana sp. nov.

General coloration light gray, prescutum with four narrow pale brown stripes; pleura uniformly clear gray; femora obscure yellow, tips conspicuously blackened; wings whitish subhyaline, variegated with pale brown and yellow; a broad, nearly complete white crossband beyond cord.

Female, length, 19 millimeters; wing, 17.

Frontal prolongation of head elongate, dark brown beneath and on sides, yellow dorsally; nasus long and slender; palpi dark brown. Antennæ with scape and basal segments of flagellum yellow; remainder of antennæ dark brown. Head yellowish gray with a delicate, capillary, brown median vitta. Mesonotal prescutum light gray with four narrow, pale brown stripes, the intermediate pair narrowed posteriorly; pseudosutural foveæ reduced to a blackened puncture; scutum gray, lobes with very pale brown centers; scutellum pale gray, the lateral sclerites darker; postnotum clear light grey. Pleura uniformly clear gray; dorsopleural membranes whitish. Halteres yellow with conspicuous dark brown knobs. Legs with coxæ light gray; trochanters yellow; femora obscure yellow, tips rather narrowly but conspicuously blackened, these areas subequal on all the legs; tibiæ dark brown, bases pale; tarsi

brownish black. Wings whitish subhyaline, base and cells C and Sc yellow; a conspicuous pale brown pattern occupies most of wing surface; stigma darker brown; the whitish ground color occupies the following areas: Before and beyond origin of Rs; a large area occupying the basal half of cell M; a semicircular area in cell M beneath origin of Rs and a smaller one at the outer end of cell; a very broad whitish crossband beyond cord, including the basal halves of cells R_2 and R_3 ; basal portion of R_5 and center of 1st M_2 , passing into cells M_3 and Cu_1 ; outer half of cell R_5 faintly pale; pale areas in cell Cu at basal third and before apex, and in cell 1st A before midlength and at margin; bases of anal cells indistinctly paler; veins dark brown, yellowish in the costal and basal regions. Abdomen with the basal segments light yellow, the terminal segments passing into darker, surface dark gray pruinose; tergites with the lateral margins narrowly whitish, the caudal margins less distinctly so. Ovipositor with the slender valves with smooth margins.

Habitat.—Japan (Hokkaido).

Holotype, female, Jozankei, August 19, 1922 (*T. Esaki*).

Tipula bubo Alexander.

Tipula bubo ALEXANDER, Journ. N. Y. Ent. Soc. 26 (1918) 69, 70.

The type locality for this handsome fly is Honshiu. Doctor Esaki's material adds the following records:

Saghalien: Toyohara, July 14 to 23, 1922; Odasam, August 5, 1922. Hokkaido: Jozankei, August 19, 1922; Kamiotoineppu, August 23, 1922.

Tipula flavocostalis Alexander.

Tipula flavocostalis ALEXANDER, Ann. Ent. Soc. Am. 14 (1921) 124, 125.

Saghalien: Toyohara, July 13 to 18, 1922 (*T. Esaki*); Kohnuma, September 1, 1921 (*S. Kuwayama*).

The type locality is Honshiu and the species has not yet been taken in Hokkaido.

Tipula taikun Alexander.

Tipula taikun ALEXANDER, Ann. Ent. Soc. Am. 14 (1921) 125, 126.

Hokkaido: Kamuikotan, August 22, 1922; Kamiotoineppu, August 24, 25, 1922; Kamiokoppe, August 27, 1922; Setonshi, August 28, 1922; Abashiri August 31, 1922; Obihiro, Tokachi Province, September 12, 1922 (*T. Esaki*).

The type locality is Morioka, Iwate-Ken, Honshiu.

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- Text in both Japanese and English; figures excellent.

ILLUSTRATIONS

[*a* = ædeagus; *b* = basistyle; *d* = dististyle; *g* = gonapophyses; *p* = proctiger; *t* = ninth tergite.]

PLATE 1

- FIG. 1. *Dicranomyia subtristis* sp. nov., hypopygium.
2. *Dicranomyia megacauda* sp. nov., rostriform appendage.
3. *Dicranomyia megacauda* sp. nov., appendage of basistyle.
4. *Dicranomyia globulithorax* sp. nov., hypopygium.
5. *Dicranomyia spinicauda* sp. nov., hypopygium.
6. *Limonia angustistria* sp. nov., dististyles.
7. *Limonia basispina* sp. nov., hypopygium.
8. *Limonia monacantha* sp. nov., hypopygium.

PLATE 2

- FIG. 9. *Antocha serricauda* sp. nov., hypopygium.
10. *Antocha bifida* sp. nov., hypopygium.
11. *Antocha brevistyla* sp. nov., hypopygium.
12. *Antocha brevinervis* sp. nov., hypopygium.
13. *Antocha satsuma* Alexander, hypopygium.
14. *Antocha dilatata* sp. nov., hypopygium.
15. *Erioptera sachalina* sp. nov., ninth tergite.
16. *Erioptera yezoana* sp. nov., ninth tergite.
17. *Erioptera sachalina* sp. nov., lateral lobe of tergite.
18. *Erioptera yezoana* sp. nov., lateral lobe of tergite.
19. *Erioptera sachalina* sp. nov., dististyle.
20. *Erioptera yezoana* sp. nov., dististyle.
21. *Erioptera flavohumeralis* sp. nov., hypopygium.
22. *Erioptera horii* sp. nov., hypopygium.



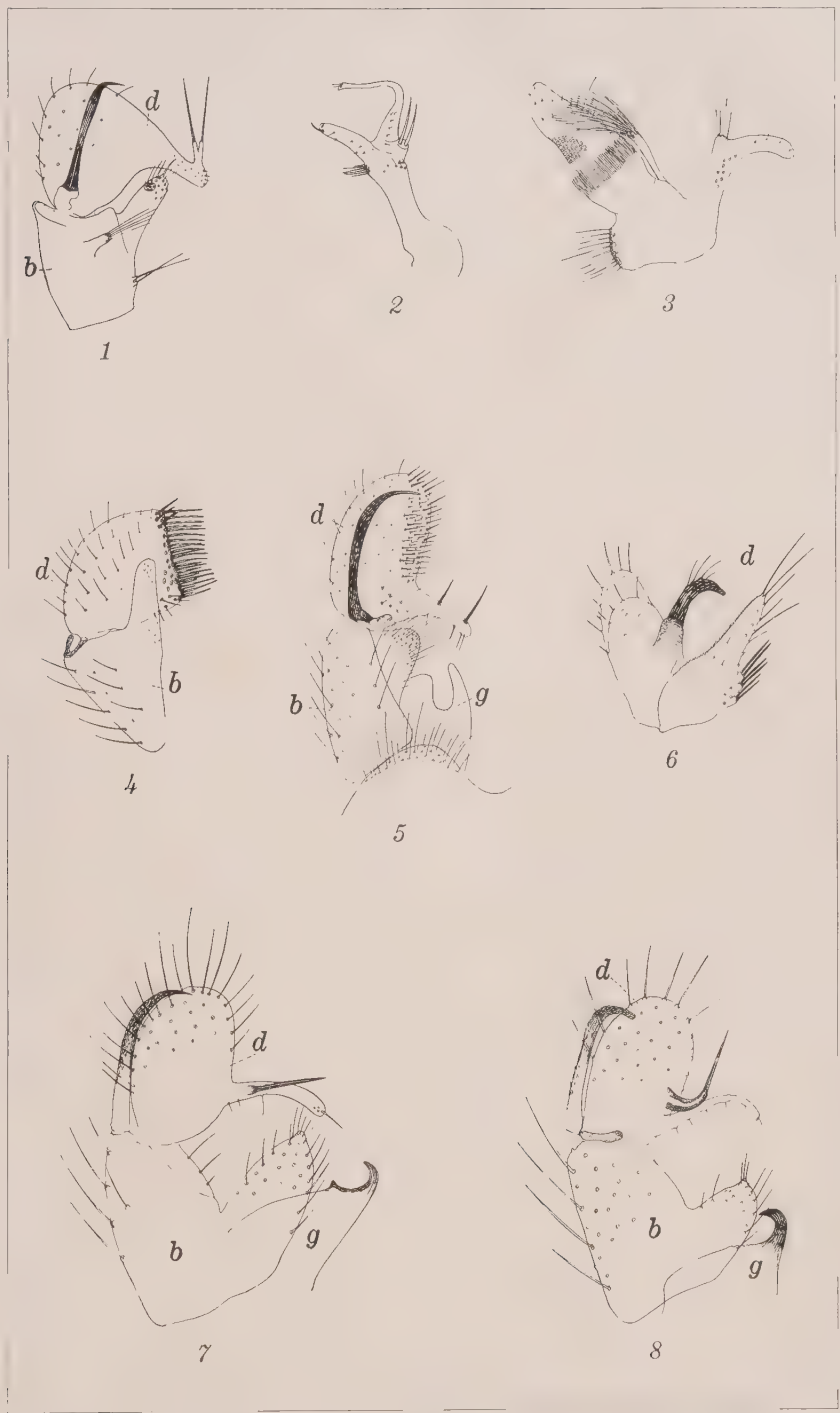


PLATE 1.

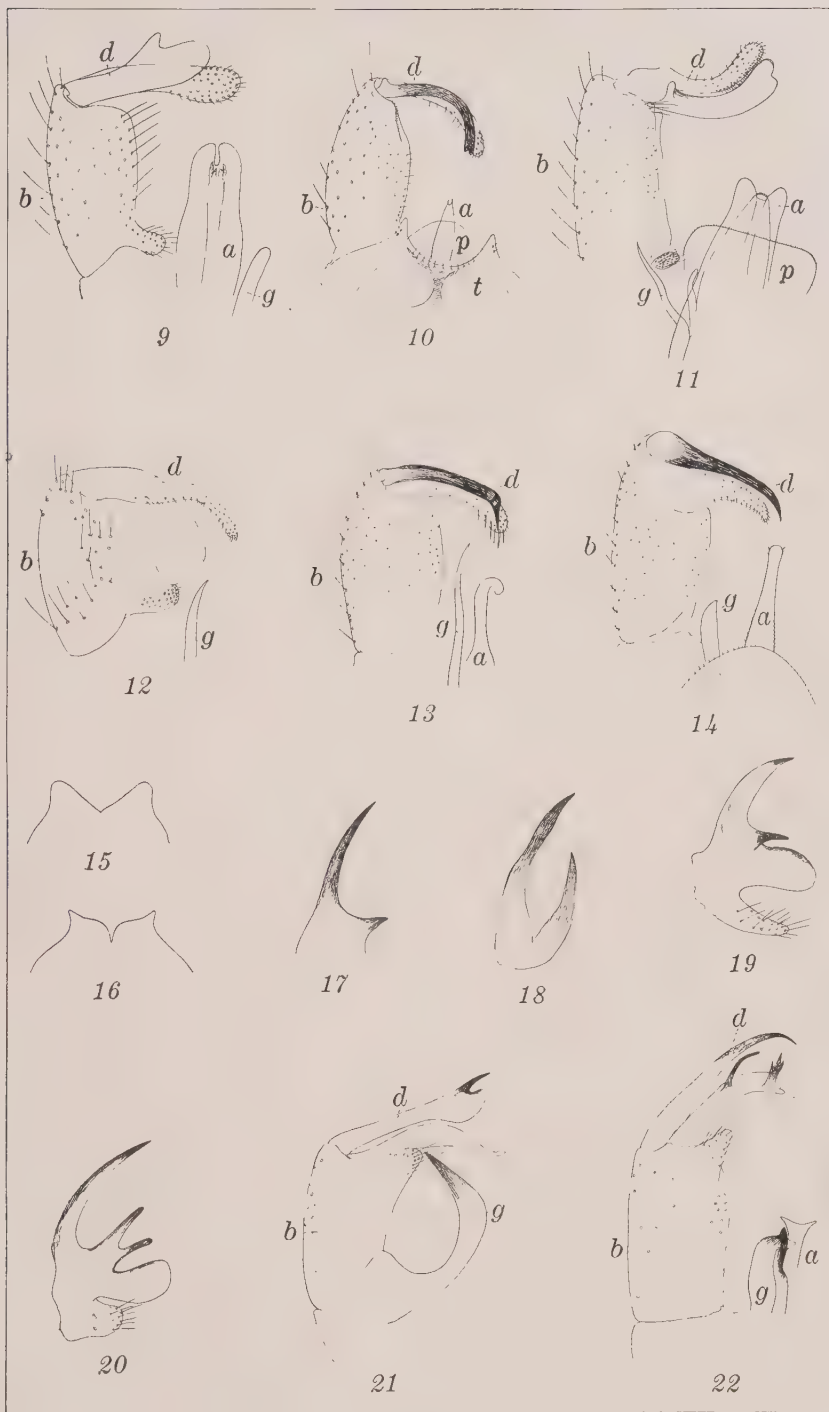


PLATE 2.

REPORT OF A SACROCOCCYGEAL TERATOMA IN A FILIPINO INFANT

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THREE PLATES

In presenting this case to add to the already profuse literature, I am moved chiefly because of the apparent rarity of these tumors among Filipinos. In a search of the records of nearly ten thousand (9,800) autopsies, covering a period of slightly over fifteen years, from the Philippine General Hospital, the San Lazaro Public Health Service Hospital, and the Manila City Morgue, I have been able to find only one other true teratoma recorded.¹ Numerous monsters have occurred and dermoid cysts of the ovary are apparently not uncommon, but the incidence of solid teratomata is practically negligible. It seems, therefore, of some importance to put this case on record. If this report will act as a stimulus to the collection by other investigators of evidence about this poorly understood group of tumors it will have served its purpose.

In a paper recently published² I have collected the reported cases of mediastinal teratomata found in children, presenting at the same time a case occurring in a girl of 4½ years. This group is very much less numerous than the cranial and sacrococcygeal groups, and is perhaps less easy to understand, on the basis of monogerminal tissue implantation. No comparable mediastinal tumors have been noted in the Philippines. In reviewing the literature of the subject, only one hundred nine cases of such mediastinal tumors could be found, the diagnosis of many of which was open to doubt due to lack of histological examination. On the other hand, the literature abounds in case reports and monographs on the teratomata of genital origin, and the sacrococcygeal variety described here is by no means uncommon.

¹ Gilman, P. K., Axillary teratoma, *Philip. Journ. Sci.* § B 8 (1913) 231.

² Smith, L. W., Mediastinal tumors in children, *Surg. Gyn. & Obst.* (1923).

It is, therefore, of considerable interest to the embryologist and anatomist, as well as the pathologist, to note the marked apparent difference in incidence of these developmental abnormalities among the Filipinos as a race. Perhaps future study will reveal whether this difference is actual or is simply the result of incomplete statistical evidence. Perhaps it may suggest a similar search in other of the less completely medically investigated countries (China, India, and Africa, for example), where this particular branch of scientific work has been neglected because of the more dramatic field of tropical disease.

I am indebted to Dr. N. M. Saleeby, director of St. Luke's Hospital, Manila, on whose service the case occurred, for the clinical notes and the privilege of publishing these observations.

CLINICAL HISTORY

Baby J., female, born November 1, 1922, at 4.45 a. m., without operative interference. She was considered full-term, and seemed normal at birth in all respects except for the presence of a large sacrococcygeal tumor (Plate 1, fig. 1). She is the second child of normal, healthy Filipino parents. The other child is living and well. There is nothing of interest or importance, otherwise, in the family history.

The baby nursed normally and passed characteristic meconium stools, which began to show evidence of normal digestion in the course of seventy-two hours. She seemed fairly strong and the advisability of operative excision of the tumor was considered. A roentgenological examination of the large bowel was made by means of a bismuth enema on November 3 (Plate 2). During the next day, beginning gangrene of a portion of the tumor was noted, and operation was decided upon as indicated, as the only possible means of saving the baby's life. During the day, however, cyanosis developed, with coldness of the extremities, and "stiffness" of the muscles. Her condition gradually became worse until, finally, ninety-two hours after birth, the baby died.

Complete autopsy was refused, but permission was given to excise the tumor for examination. The report is herewith appended.

PATHOLOGICAL REPORT

Gross.—The specimen consists of an irregularly lobulated tumor mass attached, by a broad skin peduncle and what appears to be a prolongation of the coccygeal cartilage, to the sacral region (Plate 1, fig. 2). The margins are well defined

and show no relationship externally to the anus or to the genitalia and, as seen by the X-ray picture, the rectal canal is apparently not involved. A large portion of the tumor is dark reddish, and suggests circulatory disturbances with beginning gangrene. In this dark-colored portion the epithelium is desquamated in many places, exposing a seminecrotic underlying tissue, which for the most part is unrecognizable. Other lobules still retain a healthy appearance with a somewhat thickened skin, in some places smooth, in others wrinkled. These lobules, as will be noted by reference to the plate, vary greatly in size. Certain of them seem fluctuant and suggest a cystic development; others have a resiliency which gives the impression of a loose reticulum of connective or elastic tissue fibers, not unlike the protective pads of cat's claws; still others are firm and unyielding, of a bony or cartilagenous character. The whole tumor is covered by a delicate "downy" growth of short hair, only a millimeter or two in length. In several places, however, particularly in the deeper folds between lobules, small patches of black hair several centimeters in length are found. The whole tumor varies so in gross appearance that further description of the individual lobules would be of little value.

On sectioning the tumor, the confirmatory evidence of its complex or teratoid character is apparent. It is composed of a great variety of tissues, many of which are recognizable to the naked eye. Perhaps most prominent is the bony and cartilagenous development which gives a rough framework or stroma for the other structures. This is most massive centrally. It bears no resemblance to any normal foetal bones. In the interstices there are numerous cysts, lined in some instances by a smooth, shiny epithelium, in others by a shaggy, soft, friable hæmorrhagic tissue not unlike mucous polypi. Again, islands of nervous tissue are seen, bearing no apparent relationship to the other tissues; some of the latter areas are also cystic in character, suggesting the ventricles of the brain, and are lined by a thin, smooth tissue. Large masses of unrelated striated muscle are definitely recognizable grossly, but apparently are without function. Then, fatty tissue embedded in the meshes of a loose grayish trabeculated stroma, reminiscent of areolar connective tissue, is also prominent. No definite abortive attempts to form foetal organs are found, and the whole gross appearance is that of a variety of tissues, struggling madly to outgrow one another, the whole maintained in

a semblance of order by a covering of skin, which even in places has become overpowered by the purposeless proliferation of the other tissues, with resultant necrosis.

Microscopic.—Sections taken from different portions of the tumor show very marked differences. From one lobule there is a normal skin of the thin type, almost without papillary downgrowths of the epithelium, such as is found on the anterior surface of the forearm. In this, however, the sebaceous and coil glands are relatively excessive in number. The corium too is dense, compared with a similar section of normal skin, and under the corium is a pad of loose areolar collagen fibers supporting a few fibroblasts and large amounts of fatty tissue, the whole being a strange contradiction of structure and function.

In another lobule are other sections of skin, in which the papillary downgrowth of the epithelium is much more prominent. Here, however, immediately under the dense corium there is a layer of neuroglia tissue with a cystic central area lined by a single layer of cuboidal epithelial cells, which on one side of the cyst develop into an atypical choroid plexus (Plate 3), drawing a profuse capillary blood supply from the neighboring wall. Another section from this lobule shows an island of characteristic ganglion cells, with the formation of definite non-medullated nerve fibers.

The central area of the tumor on section consists histologically of a stroma of bone, cartilage, and connective tissue. There is adult bone with an abortive haversian system, a marrow containing all types of blood cells, and evidence of osteoblast and osteoclast activity. In juxtaposition to one of these islands of bone there is a nodule of stratified epithelium resembling bladder epithelium, forming small cysts filled with desquamated cells. Also, in close approximation to the bone, there is an utterly unrelated mass of striated muscle, some of the cells arranged in characteristic bundles, others occurring singly in the midst of loose areolar tissue. The cartilagenous portion of the stroma is composed chiefly of small branching trabeculæ, some cut in cross section appearing as round islands with no obvious connection.

In another portion of the tumor there is a mass of irregularly arranged smooth muscle, surmounted by a submucosa containing small lymphoid follicles, capillaries, ganglion cells, and abortive adenomatous structures; some occluded and cystic in appearance, filled with a mucoid secretion, others opening into

a larger cystic area, presumably representing the lumen of a bit of gut.

Here, as in the gross description, a more complete cataloguing of other sections is merely a reduplication. Enough has been said to show that the tumor is a true teratoma, a parasite, developing as a monogerminal tissue implantation; a misplacement or separation of tissues within a single individual—the so-called autochthonous teratoma, and not a bigerminal implantation or abnormal twin pregnancy.

Diagnosis: Autochthonous teratoma.

ILLUSTRATIONS

PLATE 1

- FIG. 1. Tumor in situ.
2. Tumor removed.

PLATE 2

Radiograph, showing tumor mass and large bowel.

PLATE 3

Abortive choroid plexus. Photomicrograph, low power.



Fig. 1. Tumor in situ.



Fig. 2. Tumor removed.

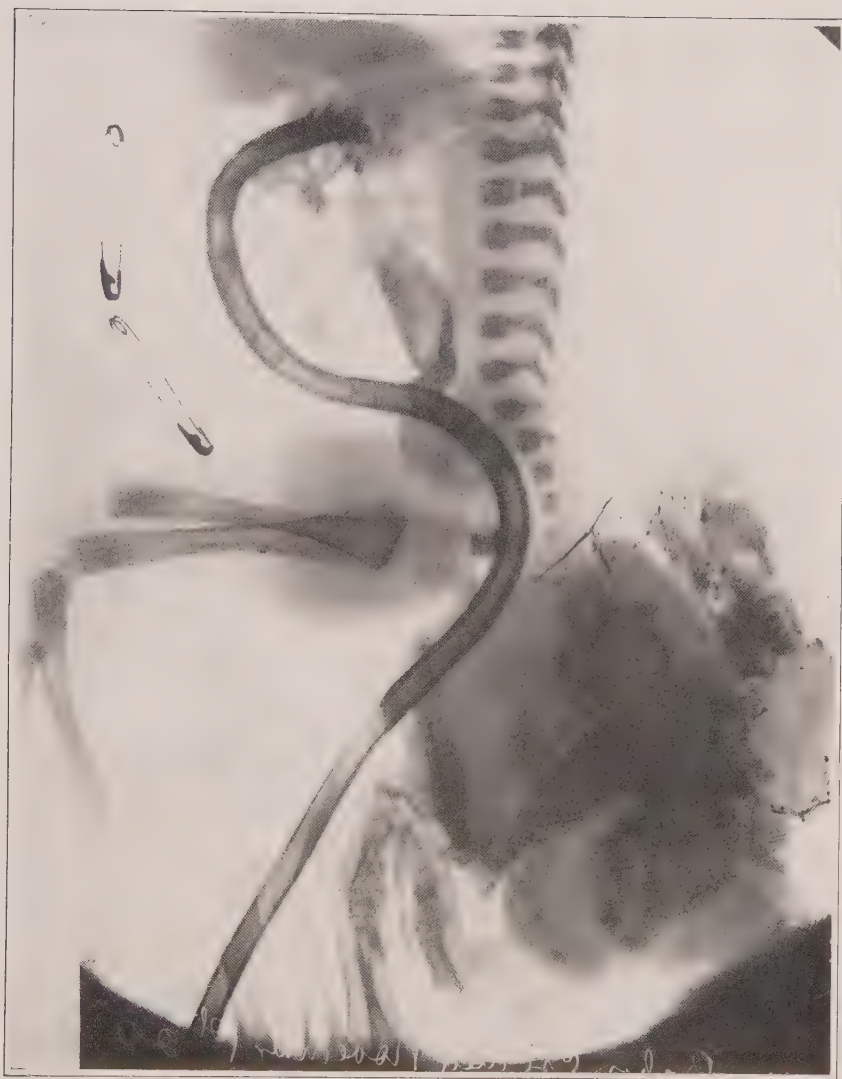


PLATE 2. RADIOGRAPH, SHOWING TUMOR MASS AND LARGE BOWEL.

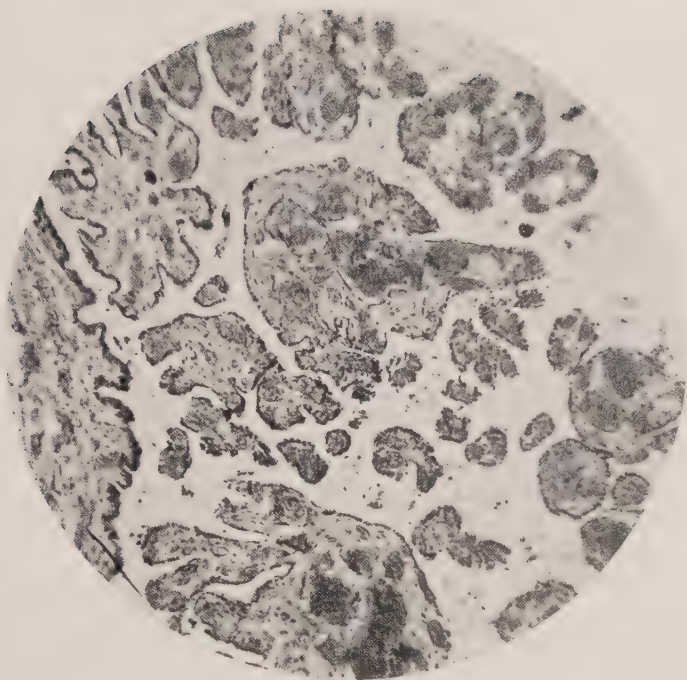


PLATE 3. ABORTIVE CHOROID PLEXUS. PHOTOMICROGRAPH, LOW POWER.

CHAULMOOGRA ETHYL, PROPYL, BUTYL, AND AMYL ESTERS¹

By GRANVILLE A. PERKINS

Chief Chemist, Culion Leper Colony

ONE PLATE AND TWO TEXT FIGURES

Chaulmoogra ethyl esters (more correctly the mixed ethyl esters of the fatty acids which occur and whose glycerides occur in chaulmoogra oil) have been made and used for some time at Culion Leper Colony. During that time a few simple studies have been made resulting in improvements on the process² originally used and these studies have been extended at the suggestion of Dr. H. W. Wade, chief pathologist, to include the preparation of other esters, the therapeutic value of which is now being tested by the clinical staff. It is the purpose of the present paper to record the results obtained from these chemical studies, in so far as they may be of general interest, and the methods of preparation used by us at the present time.

EXPERIMENTAL PREPARATION OF CHAULMOOGRA ETHYL ESTERS

The method of preparation which requires the preliminary liberation of the fatty acids has never been used by us on a large scale, on account of the greater economy of the direct process. Recent improvements in the preparation reaction itself have been in the direction of cutting down the amount of alcohol used. Although we have distilled the washings to recover the excess alcohol we have always lost considerable amounts, partly by mechanical loss, in the neutralization and repeated fractionations involved, and partly by formation of ether during the reaction with chaulmoogra oil. We have not been able to recover this ether economically due to the comparatively high temperature of our cooling water.

Since the reaction between alcohol, chaulmoogra oil, and sulphuric acid, as we have carried it out, is a heterogeneous

¹ Submitted for publication August 12, 1923, with the permission of the Director of Health and approval of the Philippine Leprosy Research Board.

² Perkins, G. A., *Philip. Journ. Sci.* 21 (1922) 1.

one, and therefore not only varying in speed according to the amount of stirring, but also necessitating a higher temperature or much more time or catalyst than a homogeneous reaction, experiments were made as to the intersolubility of the liquids involved. The solubility of chaulmoogra oil in an excess of alcohol is too slight to consider carrying out the reaction in this kind of solution. On the other hand, alcohol, if dehydrated, is quite soluble in an excess of chaulmoogra oil. At room temperature (30° C.) chaulmoogra oil dissolves about 68 per cent of its volume of 99 per cent alcohol. This solution, or even one containing less alcohol, is quite unstable toward the addition of somewhat polar substances. For example, a solution of 10 mils alcohol in 30 mils chaulmoogra oil is clouded immediately by the addition of a few bubbles of dry hydrochloric acid gas, by the addition of 0.04 mil sulphuric acid, or by the addition of a few drops of glycerol or 90 per cent alcohol. As an acid catalyst is necessary, glycerol is a product of the desired reaction, and water is difficult to remove from 95 per cent alcohol, it was decided that a homogeneous reaction mixture is practically unobtainable. Nevertheless, for the purpose of studying the reaction, especially in comparison with other alcohols which mix readily with oils, two reaction mixtures were prepared which were homogeneous at the outset. These were made with 99 per cent alcohol. In one case (Table 2, mixture C) very little sulphuric acid was used, and in the other (Table 2, mixture A) ether was added to act as solvent. These mixtures, like all the rest mentioned in this paper, did not remain homogeneous, but soon gave a separate layer containing glycerol, alcohol, and sulphuric acid. This separation was not entirely detrimental to the reaction, as it removed some of the glycerol from the main reacting layer. A third mixture (Table 2, mixture B) was made up, with the use of dry hydrochloric acid gas as a catalyst. This had two layers from the start, no ether being added.

Table 1 shows the characteristics of the chaulmoogra oil used in the above-mentioned mixtures. Table 2 gives the results of the experiment.

TABLE 1.—*Characteristics of the chaulmoogra oil used for experimental preparation of ethyl, propyl, butyl, and amyl esters.*

Refractive index, $n_{30/D}$	1.4757
Acidity (as oleic), per cent	18.2
Specific gravity, 30/30	0.9497
Optical rotation 10 centimeters/30/D, degrees	44.5

Amounts of reagents.—The composition of the three mixtures is shown in Table 2. Two hundred seventy-six grams of chaulmoogra oil were taken for mixtures A and B. This was the amount found to be equivalent to one mol of alkali (in the process of saponification). Two mols of alcohol were used, and this quantity is shown by the results of the experiment to be sufficient for thorough conversion to ethyl ester. Mixture C was measured in round numbers of mls, with about 2.5 molecular equivalents of alcohol.

Three-hundredths of a mol of acid was used in A and B, this being the quantity of sulphuric acid that could be added to the normal propyl alcohol mixture (see Table 5) without causing separation into two layers. One-tenth mil of sulphuric acid was chosen for mixture C, being practically the maximum that could be added to this mixture without causing separation into two layers.

Study of the reaction.—The three mixtures were placed in stoppered bottles of 8 centimeters inner diameter, and allowed to stand at room temperature (averaging 30° C. with a daily variation of about 4° C.). The mixtures were stirred only before taking samples. After about two months the reaction was finished by boiling gently. The mixture catalyzed by hydrochloric acid became dark red on standing, and all became darker on boiling. Mixtures A and B retained a small glycerol layer on boiling, but mixture C became homogeneous again on boiling.

The course of the reaction was traced rather easily with a refractometer. Samples of about 5 mls were taken at the intervals shown in Table 2. Each sample was washed with 20 mls of water to remove mineral acid and steamed to remove alcohol. The refractive index was then taken at room temperature and corrected to 30° C. allowing for a drop of 0.0004 per degree temperature rise, as determined by experiment. The sample thus tested was essentially a mixture of unchanged oil and newly formed chaulmoogra ethyl esters, and the refractive index varied considerably according to the relative amounts of these two constituents. The distilled and purified ester from mixture A had a refractive index of 1.4563 (see Table 1) and that from mixture B, 1.4566. The product from mixture C was excluded on account of high acidity, so the average of 1.45645 was taken as the refractive index of the ethyl esters from the sample of chaulmoogra oil in hand. The total decrease in

refractive index from oil (1.4757) to ethyl ester (1.45645) was therefore 0.01925. Assuming the decrease of refractive index to be proportional to the amount of ethyl ester in the various samples tested, this decrease (from 1.4757) in each case was divided by 0.0001925 to find the percentage of ethyl ester. The proportionality above assumed is evidently close to the actual fact, as a mixture of 5 grams ethyl ester of refractive index 1.4563 with 5 grams of chaulmoogra oil of index 1.4757 was found to have an index of 1.4660, exactly the average. The calculated percentages of ethyl ester in the samples freed, as above described, from alcohol and solvent are given in Table 2 and shown as graphs in fig. 1. Due to the presence of free fatty acids, mono- and di-glycerides, and other constituents of unknown effects, the calculated percentages cannot be considered accurate, but they certainly have a comparative value.

Effect of added ether.—To ascertain whether ether has any esterifying effect of its own, a mixture (fig. 1, mixture D) of 2 mols dry ether, 0.03 mol sulphuric acid, and 1 equivalent (276 grams) of chaulmoogra oil was studied. This mixture reacted very slowly (see fig. 1), the refractive index at sixty-six days being 1.472, which corresponds to about 19 per cent ethyl ester.

The direct chemical effect of the ether in mixture A was, judging from mixture D, not enough to balance the slowing down of the reaction by its diluting effect. Nevertheless, mixture A reacted more rapidly than B (see fig. 1), as was to be expected from the fact that the ether increased the intersolubility of the alcohol and chaulmoogra oil.

During the boiling of mixture A the ether was driven off so that it was not a factor in the final result.

The effect of the catalyst.—The greater rapidity in the early stages of the reaction in mixture A cannot be ascribed to the sulphuric acid used, because this acid was found to be practically equivalent to hydrochloric in the first part of the reaction with propyl and butyl alcohols (see Tables 5 and 7) when no ether was used. The higher final value of ester in mixture A, however, indicates that sulphuric acid produces a distribution of alcohol and glycerol in the two layers which is more favorable to the production of ethyl ester than the distribution occurring in the presence of hydrochloric acid.

Mixture C (see fig. 1) had evidently too little catalyst for practical purposes, either for a reaction in the cold or for boiling.

Isolation of ethyl ester from the crude reaction mixture.—When the reaction had practically ceased, as shown by the refractive index tests, mixtures A, B, and C were washed with water to remove alcohol and sulphuric acid. (Mixture D was discarded.) The acidity at this stage was comparatively low, as is shown in Table 2. Nevertheless, difficulty was encountered in the next stage, that of removing the free fatty acid. The reason for removing this was that early in our work on chaulmoogra ethyl esters we found difficulty in distillation, which we ascribed to the free fatty acid. Since then we have, until recently, washed with alkali before distilling.

The method used in washing mixtures A and B was the one that has been found fairly successful in our routine practice; namely, to mix with about two volumes of cold water, make slightly alkaline, and put on a warm plate or steam bath until the emulsion separates. Three faults were found in this method; first, that a slightly alkaline solution may be in equilibrium with ester containing appreciable free fatty acid; second, that the emulsions required a long time to separate, especially if more than very slightly alkaline; and third, that the emulsions often hydrolyzed on long heating so as to become more acid than they were originally. The simple expedients of using hot instead of cold water and of adding sufficient excess of alkali were found to obviate these difficulties, but the data on mixtures A and B are examples of the result of starting the emulsion cold. No acidity data were taken, but the refractive index (Table 2) shows the presence of free fatty acid in each case. Mixture C was treated with benzene to extract the ester, and alcohol was added to break the emulsion. The benzene was later removed by distillation with steam. The loss of ester was high and the refractive index was not reduced.

The washed products were distilled in a vacuum of about 10 millimeters pressure. A 500-mil Pyrex "creosote" distilling flask was used, and two small pieces of copper gauze were inserted in the neck to prevent splashing over. A pebble was added to minimize bumping.

The proportion of residue to distillate (Table 2) was found to correspond as closely as would be expected to the calculated percentages of unchanged oil and ethyl ester.

The yields of final product were very low, especially from mixture C, but this is obviously due to the repeated sampling and the experimentation on separation of emulsions. Yield data are given in the following section.

TABLE 2.—*Experimental preparation of chaulmoogra ethyl esters.*

	Mixture A.	Mixture B.	Mixture C.
Composition of mixture:			
Chaulmoogra oil.....	276 grams (equivalent to 1 mol).	276 grams (equivalent to 1 mol).	100 mls.
Ethyl alcohol, 99 per cent.	93 grams (2 mols)---	93 grams (2 mols)---	50 ml. (2.5 mole equivalent).
Sulphuric acid, 95 per cent.	3.1 grams (0.03 mol)---	None -----	0.1 ml. (0.005 mol equivalent).
Hydrochloric acid, dry.	None -----	1.1 grams (0.03 mol)---	None.
Ethyl ether, dry ----	148 grams (2 mols)---	None -----	None.
Refractive index, $n_{30/D}$, and calculated per cent ethyl ester after standing—			
1 hour -----	1.4752, 3 per cent.---	-----	
2 hours -----	1.4749, 4 per cent.---	-----	
5 hours -----	1.4739, 9 per cent.---	-----	
10 hours -----	1.4730, 14 per cent.---	-----	
1 day -----	1.4713, 23 per cent.---	1.4733, 12 per cent.---	1.4737, 10 per cent.
2 days -----	1.4691, 34 per cent.---	1.4724, 17 per cent.---	1.4732, 13 per cent.
3 days -----	1.4682, 39 per cent.---	1.4710, 24 per cent.---	1.4730, 14 per cent.
4 days -----	1.4668, 46 per cent.---	1.4701, 29 per cent.---	
6 days -----	1.4641, 60 per cent.---	-----	
7 days -----	-----	-----	1.4731, 14 per cent.
8 days -----	-----	1.4680, 40 per cent.---	
10 days -----	1.4619, 72 per cent.---	-----	
14 days -----	1.4614, 74 per cent.---	-----	
59 days -----	-----	-----	1.4699, 30 per cent.
60 days -----	-----	1.4594, 85 per cent.---	
66 days -----	1.4585, 90 per cent.---	-----	
Refractive index, $n_{30/D}$, and calculated per cent ethylester after boiling—			
3 hours -----	1.4581, 92 per cent.---	-----	
10 hours -----	-----	-----	1.4641, 60 per cent.
12 hours -----	-----	1.4588, 88 per cent.---	
24 hours -----	-----	1.4588, 88 per cent.---	1.4618, 72 per cent.
28 hours -----	1.4573, 96 per cent.---	-----	
48 hours -----	-----	-----	1.4611, 76 per cent.
72 hours -----	-----	-----	1.4607, 78 per cent.
Product washed with water:			
Acidity (as per cent oleic).	3.4 -----	3.1 -----	3.3
Product washed with alkali:			
Weight -----	166 grams -----	188 grams -----	28 grams.
Refractive index, $n_{30/D}$.	1.4580 -----	1.4587 -----	1.4607
Product distilled:			
Weight -----	151 grams -----	146 grams -----	23 grams.
Acidity (as per cent oleic).	4.0 -----	1.8 -----	4.1.

TABLE 2.—Experimental preparation of chaulmoogra ethyl esters.—Cont.

	Mixture A.	Mixture B.	Mixture C.
Residue in still, weight....	6 grams.....	17 grams.....	2 grams.
Distillate washed with alkali:			
Weight.....	107 grams.....	129 grams.....	6 grams.
Refractive index, $n_{30/D}$.	1.4563.....	1.4566.....	(1.4574).
Acidity (as per cent oleic).	0.55.....	0.55.....	4.1
Specific gravity, 30/30.	0.902.....	0.902.....	
Optical rotation, 10 centimeters/30/D.	35.9°.....	35.9°.....	28.1°

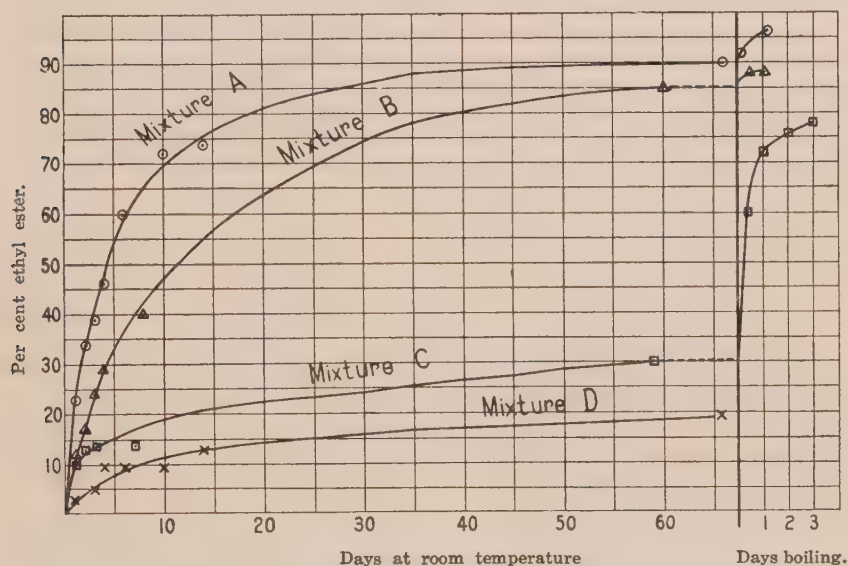


FIG. 1. Experimental preparation of chaulmoogra ethyl esters.

PRESENT METHOD OF MANUFACTURE OF CHAULMOOGRA ETHYL ESTERS

In our routine preparation of chaulmoogra ethyl esters at Culion Leper Colony we originally used a large excess of alcohol to insure complete reaction, but have gradually been economizing on the alcohol consumption. The proportions used by us at present are 10 liters chaulmoogra oil, 5 liters alcohol (95.5 per cent by volume), and 100 mls sulphuric acid. This mixture has been found by Mr. A. O. Cruz, who is in charge of

this process, to give good results if the boiling is vigorous and is continued for about forty-eight hours. The principal advantage of vigorous boiling is undoubtedly that it keeps the two layers well mixed. Samples taken after twenty-four hours vigorous boiling show, after washing, a refractive index of about 1.4590, while the forty-eight-hour samples have an index of about 1.4575. The boiling is done in stoneware acid carboys of 26-liter capacity set in concrete tubs which serve as steam jackets. The alcohol vapor is condensed and returned to the boiling mixture by condensers of 13-millimeter brass pipe 1.5 meters long with water jackets of 38-millimeter galvanized iron pipe soldered on (Plate 1, fig. 1).

Typical data on the reaction are shown in Table 3.

TABLE 3.—Routine preparation of chaulmoogra ethyl esters, reaction data.

Run No.	Twenty-four hour sample.		Forty-eight hour sample.	
	Refractive index.	Acidity.	Refractive index.	Acidity
		Per cent.		Per cent
125-----	1.4591	3.7	1.4576	3.7
126-----	1.4584	3.9	1.4573	3.7
127-----	1.4595	3.9	1.4583	3.7
128-----	1.4591	4.6	1.4575	3.7

The contents of the carboy are washed three times with about 20 liters of water, and then dried in a steam kettle. The yield from 10 liters of oil is about 11 liters. The first washing is neutralized with lime and fractionally distilled to recover the alcohol which it contains.

Distillation (Plate 1, fig. 2).—The chaulmoogra ethyl esters are distilled at about 30 millimeters pressure in essentially the same apparatus that was previously used at the Bureau of Science.³ We have recently had the top and bottom of the body of the still welded on, as troublesome leaks developed in the screwed joints in spite of the use of cement. The joint between the still head and the reducing coupling which forms the top of the body gives no trouble if covered with good fire-

³ Perkins, G. A., Philip. Journ. Sci. 21 (1922) 8. The body is of 15-centimeter iron pipe, 30 centimeters long, and still head 5 by 150 centimeters.

proof cement, but we find extra-heavy pipe advisable for the still head as frequent use of the wrench upon it is necessary. The air condenser is of 13-millimeter pipe, with vacuum connection at a tee. Breakage of the receiver was obviated by replacing the separatory funnel with a 500-mil leveling bulb, the outlet of which is attached by cement and pipe fittings to a brass stopcock.

The electric heater for the body of the still has been replaced by a New Perfection single-burner stove, the chimney of which is fitted almost airtight to a length of 250-centimeter stove-pipe. This stovepipe, surrounded and extended upward by insulation of asbestos pipe covering, forms a hot air bath for the still and still head. A wrapping of 25 turns of No. 22 Chromel A wire around the still head is used for auxiliary electric heating (110 volts).

Attempts have been made to remove the residue through a hole near the bottom of the still, but a portion of the residue usually becomes carbonized and spongy, so that it is necessary to take the still apart for cleaning. No solvent has been found for this spongy mass, though boiling solvent naphtha or kerosene softens it. Usually we unscrew the still head after distilling about 50 liters, heat the body, and pour out any liquid contents. Upon further heating the spongy contents become brittle and are then scraped out.

Washing with alkali.—Free fatty acid has been found to be irritating, so we aim to reduce this to a minimum in all drugs which are to be injected. This may be done by washing with alkali either before or after distilling. Removal of fatty acid before distillation seems to make distillation somewhat smoother, and practically no rise in acidity occurs during well-regulated distillation, so this is the method which we used for some time. At present, however, we are washing after distillation, because this was sometimes found advisable even if the ester was washed before distillation, because the distilled ester has less tendency to emulsify, and because the alkali is useful in removing impurities, such as traces of aldehydes, which are formed during distillation. Typical results from washing before and after distillation are shown in Table 4. It may be seen that the yield of purified ester from 10 liters of chaulmoogra oil is, by our present method, exemplified by run No. 133, about 9 liters.

TABLE 4.—*Chaulmoogra ethyl esters washed with alkali before and after distillation.*

	Run No.	
	132	133
Crude ester:		
Volume liters..	11	11
Refractive index $n/30/D$	1.4580	1.4574
Acidity (as per cent oleic)	4.4	4.3
Ester washed with alkali:		
Volume liters..	7.0	
Acidity (as per cent oleic)	0.5	
Ester distilled:		
Volume liters..	6.3	9.4
Acidity (as per cent oleic)	1.8	3.0
Distillate washed with alkali:		
Volume liters..		9.0
Acidity (as per cent oleic)		0.2

About 10 liters of distilled ester are placed in a 26-liter stoneware carboy, and steam is passed through for two hours, or until the sharp odor produced by heating has disappeared. The contents of the carboy are transferred to a copper kettle in which 40 grams of sodium hydroxide have been dissolved in sufficient boiling water to make, with the water contained in the carboy, 20 liters. The mixture is stirred without further heating and allowed to settle for half an hour. The lower layer is drawn off and put in a barrel for recovery of fatty acid. The upper layer is washed twice with its own volume of boiling water. When all the deposited water has been removed the ester is filtered and sterilized by heating to 150° C. in small bottles. The acidity (about 0.2 per cent) and optical rotation (about 40.5°) of each lot are recorded. The refractive index, $n/30/D$, is about 1.4559, and the specific gravity, $30/30$, about 0.901.

Since the addition of a small amount of iodine has been found by the medical staff to reduce the irritating effects of chaulmoogra ethyl esters, most of this drug is mixed with 0.5 per cent iodine before use. It has further been found that iodine increases rather than decreases the irritating effects unless the mixture is heated for some time. The change on heating may be observed as a change in color from green to reddish brown. We take care always to produce the brown color. Another important point is thorough drying of the ester before the addition of iodine, since we find that the latter

effects by catalysis the hydrolysis of several per cent of the ester if water is present.

A mixture of the iodized esters with 10 per cent of creosote (U. S. P.) has been reported upon very favorably by the medical staff and tentatively adopted on an extensive scale. We cannot state at present whether any detrimental reaction between the creosote and iodine is likely to occur, but use the following method of preparation to avoid any such reaction:

Nine liters of purified chaulmoogra ethyl esters are heated to 150° C. to drive off suspended and dissolved water. Forty-five grams of iodine are stirred in, and the mixture is cooled and filtered. The mixture is then heated to 160° C. for two hours, or until brown, 1 liter of perfectly clear, anhydrous, U. S. P. creosote is added, and the whole transferred to sterile bottles without further heating.

EXPERIMENTAL PREPARATION OF CHAULMOOGRA PROPYL ESTERS

The propyl alcohols are more soluble in chaulmoogra oil than is ethyl alcohol, and therefore form a homogeneous reaction mixture more readily with it. Experiments using these alcohols were run in parallel with those described above using ethyl alcohol. The proportion used and results obtained are shown in Table 5. The alcohols gave no evidence of water when tested with anhydrous copper sulphate. The chaulmoogra oil used was the same as that described in Table 1.

All three mixtures were homogeneous at the start, but after a few days a lower glycerol layer appeared in each which persisted even in the final boiling.

Primary (*normal*) propyl alcohol reacted rapidly and completely in the presence of sulphuric acid (see fig. 2, A_p). Due to errors mentioned above in connection with the ethyl esters the figures indicate slightly more than 100 per cent of ester. Hydrochloric acid (fig. 2, B_p) was equally effective as a catalyst in the early stages of the reaction, but did not carry it to completion. Evidently the glycerol did not separate out so completely in this case. Secondary (*iso*-) propyl alcohol (fig. 2, A_s) reacted more slowly, as would be expected from the general behavior of secondary alcohols.

The final boiling caused very little change, although the temperature, about 100° C., was sufficient to accelerate the reaction considerably. The final result was accordingly accepted as close to equilibrium.

Recovery of alcohol.—The excess alcohol was removed by washing with water, and the wash waters were distilled through a fractionating column. The distillate coming over at 80 to 95° C. was treated with calcium chloride and the lower layer which formed removed. This process was repeated until no more calcium chloride would dissolve, and the upper layer was measured. Such an upper layer contains about 0.7 gram of recoverable alcohol per mil, and we have calculated the figures in Table 5 on this basis. The further treatment, which was carried out after combining the crude alcohol from several experiments, consisted in heating with calcium oxide and distilling. The recovery yields were of course low, due not only to the nature of the process, but also to the repeated sampling of the original mixture.

Purification.—The final treatment of the propyl esters was approximately the same as that described above for the ethyl esters. The same high losses from refractory emulsions are shown in Table 5. The low rotatory power of the product from mixture B_p is probably ascribable to too slow distillation. Continued heating above 200° has been found to lower the rotation, probably by racemization.

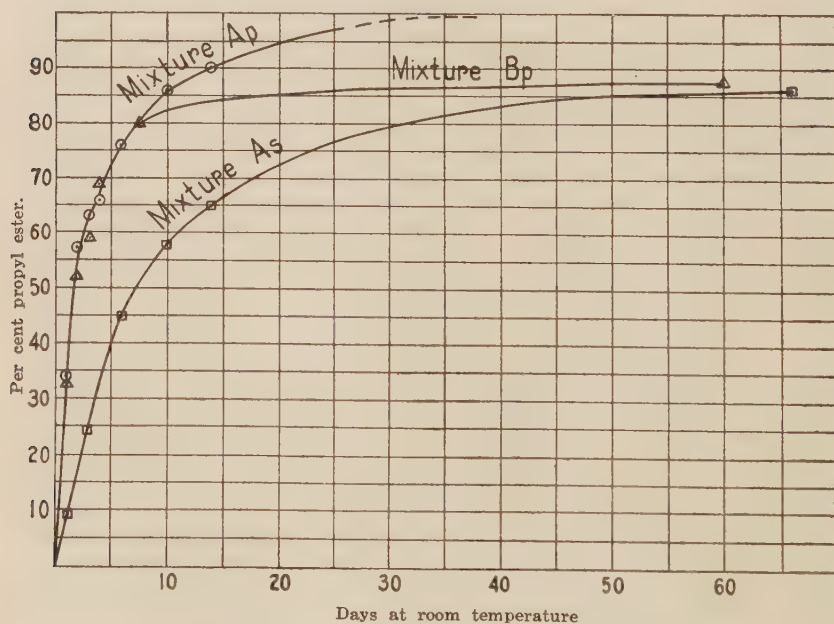


FIG. 2. Experimental preparation of chaulmoogra propyl esters.

TABLE 5.—*Experimental preparation of chaulmoogra propyl esters.*

	Mixture A _p .	Mixture B _p .	Mixture A _s .
Composition of mixture:			
Chaulmoogra oil.....	276 grams (equivalent to 1 mol).	276 grams (equivalent to 1 mol).	276 grams (equivalent to 1 mol).
Propyl alcohol, primary.	120 grams (2 mols) ..	120 grams (2 mols) ..	None.
Propyl alcohol, secondary.	None.....	None.....	120 grams (2 mols).
Sulphuric acid, 95 per cent.	3.1 grams (0.03 mol)	None.....	3.1 grams (0.03 mol).
Hydrochloric acid, dry	None.....	1.1 grams (0.03 mol)	None.
Ethyl ether, dry.....	None.....	None.....	87 grams (0.5 mol).
Refractive index, $n_{30/D}$, and calculated per cent propyl ester after standing—			
1 hour.....	1.4749, 4 per cent..	.....	1.4758
2 hours.....	1.4741, 9 per cent..	.....	1.4754, 1 per cent.
5 hours.....	1.4728, 16 per cent..	.....	1.1752, 2 per cent.
10 hours.....	1.4718, 21 per cent..	.....	1.4747, 5 per cent.
1 day.....	1.4695, 34 per cent..	1.4696, 33 per cent..	1.4738, 9 per cent.
2 days.....	1.4652, 57 per cent..	1.4661, 52 per cent..	.....
3 days.....	1.4644, 63 per cent..	1.4648, 59 per cent..	1.4703, 24 per cent.
4 days.....	1.4636, 66 per cent..	1.4630, 69 per cent..	.....
6 days.....	1.4617, 76 per cent..	.....	1.4658, 45 per cent.
8 days.....	.....	1.4611, 80 per cent..	.....
10 days.....	1.4600, 86 per cent..	.....	1.4627, 58 per cent.
14 days.....	1.4592, 90 per cent..	.....	1.4613, 65 per cent.
60 days.....	.....	1.4598, 87 per cent..	.....
66 days.....	1.4567, 102 per cent.	.....	1.4567, 86 per cent.
Refractive index, $n_{30/D}$, and calculated per cent propyl ester after boiling—			
5 hours.....	.....	1.4595, 88 per cent..	.....
6 hours.....	1.4570, 101 per cent.	.....	1.4563, 87 per cent.
Alcohol recovered:			
Weight.....	30 grams.....	31 grams.....	35 grams.
Mols.....	0.50.....	0.52.....	0.58
Product washed with water:			
Weight.....	.....	.....	216 grams.
Acidity (as per cent oleic).	3.2.....	4.3.....	8.4
Product washed with alkali:			
Weight.....	172 grams.....	145 grams.....	139 grams.
Refractive index, $n_{30/D}$.	1.4582.....	.....	1.4556
Fatty acid recovered:			
Weight.....	26 grams.....	76 grams.....	74 grams.
Product distilled:			
Weight.....	140 grams.....	102 grams.....	120 grams.
Acidity (as per cent oleic).	5.2.....	3.4.....	3.2

TABLE 5.—*Experimental preparation of chaulmoogra propyl esters—Cont.*

	Mixture A _p .	Mixture B _p .	Mixture A _s .
Residue in still, weight....	23 grams.....	30 grams.....	10 grams.
Distillate washed with alkali:			
Weight.....	126 grams.....	50 grams.....	108 grams.
Refractive index, $n_{30/D}$	1.4574.....	1.4573.....	1.4535
Acidity (as per cent oleic).....	0.33.....	0.35.....	0.22
Specific gravity 30/30.....	0.901.....	0.904.....	0.894
Optical rotation, 10 centimeters /30/D.....	33.1°.....	30.7°.....	37.8°

PRESENT METHOD OF PREPARATION OF CHAULMOOGRA PROPYL ESTERS

We have made only a few runs with primary propyl alcohol, the one shown in Table 6 being the latest. These esters are being used experimentally in small quantities by the medical staff.

TABLE 6.—*Routine preparation of chaulmoogra propyl esters, run 3.*

Chaulmoogra oil, ml.....	600
N-propyl alcohol, ml. (2 equivalents).....	300
Sulphuric acid, ml.....	1
Temperature (boiling), °C.....	91-103
Time, hours.....	5
Refractive index $n_{30/D}$	1.4586
Product washed with alkali, ml.....	480
Fatty acid recovered, grams.....	155
Alcohol recovered, ml. (0.73 equivalent).....	110
Product distilled:	
Volume, ml.....	380
Acidity (as oleic), per cent.....	2.3
Residue in still, grams.....	41
Distillate washed with alkali:	
Volume, ml.....	320
Acidity, per cent.....	0.50
Optical rotation, 10 centimeters/30/D, degrees....	38.3

EXPERIMENTAL PREPARATION OF CHAULMOOGRA BUTYL AND AMYL ESTERS

Experiments using *n*-butyl and *iso*-amyl (amyl, pure, Merck, principally *iso*-amyl) alcohols were made in parallel with those using ethyl and propyl alcohols. The data are given in

Table 7. These alcohols are less readily thrown out of solution in chaulmoogra oil than are the propyl alcohols, but the glycerol formed in the reaction soon produced a separate liquid layer as in the former cases. The same lot of chaulmoogra oil was used as before (see Table 1). The alcohols showed no water when tested with copper sulphate.

The graphs for butyl and amyl alcohol are not shown, as those for mixtures A_b and A_a (Table 7) are almost identical with A_p in fig. 2 and that for B_b (Table 7) is very close to B_p in fig. 2.

The purification of the butyl and amyl products differed somewhat from that of the propyl esters. The reaction mixture was washed with water to remove mineral acid, after which both layers were distilled separately with steam to remove the excess butyl or amyl alcohol. The lower layer of the combined distillate was again steam distilled, and the process was repeated once or twice more, each distillation being continued until the condensate was practically odorless. It was found advisable to collect each distillate in two portions, the cut being made when the liquid dropping from the condenser no longer had two layers. After three or four distillations the lower layer of the distillate was so small that it could be discarded, and all the combined upper layers from the distillates were treated with calcium chloride. The lower layer was pipetted off and calcium chloride added. After standing a few hours the alcohol was poured off and redistilled.

The ester from which excess alcohol had been removed was distilled without previous washing with alkali in the cases of mixtures B_b and A_a. Otherwise the procedure was similar to that described for the propyl esters.

TABLE 7.—*Experimental preparation of chaulmoogra butyl and amyl esters.*

	Mixture A _b .	Mixture B _b .	Mixture A _a .
Composition of mixture:			
Chaulmoogra oil ----	276 grams (equivalent to 1 mol).	276 grams (equivalent to 1 mol).	276 grams (equivalent to 1 mol).
Butyl alcohol, <i>normal</i> --	148 grams (2 mols) --	148 grams (2 mols) --	None.
Amyl alcohol, <i>iso</i> ----	None -----	None -----	176 grams (2 mols).
Sulphuric acid, 95 per cent.	3.1 grams (0.03 mol).	None -----	3.1 grams (0.03 mol).
Hydrochloric acid, dry.	None -----	1.1 grams (0.03 mol)	None.

TABLE 7.—*Experimental preparation of chaulmoogra butyl and amyl esters—Continued.*

	Mixture Ab.	Mixture Bb.	Mixture Aa.
Refractive index, $n/30/D$ and calculated per cent butyl (or amyl) ester after standing—			
1 hour	1.4743, 8 per cent		1.4743, 7 per cent.
2 hours	1.4739, 10 per cent		1.4726, 16 per cent.
5 hours	1.4724, 18 per cent		1.4724, 18 per cent.
10 hours	1.4713, 24 per cent		1.4708, 26 per cent.
1 day	1.4679, 42 per cent	1.4794, 34 per cent	1.4675, 44 per cent.
2 days	1.4647, 59 per cent	1.4664, 49 per cent	1.4646, 59 per cent.
3 days	1.4629, 69 per cent	1.4639, 63 per cent	1.4628, 69 per cent.
4 days	1.4622, 73 per cent	1.4625, 66 per cent	1.4613, 77 per cent.
6 days	1.4601, 84 per cent		1.4596, 80 per cent.
8 days		1.4603, 83 per cent	
10 days	1.4586, 92 per cent		1.4582, 93 per cent.
14 days	1.4585, 93 per cent		1.4581, 94 per cent.
60 days		1.4581, 92 per cent	
66 days	1.4572, 99 per cent		1.4569, 100 per cent.
Refractive index, $n/30/D$ and calculated per cent butyl (or amyl) ester after boiling 2 hours.	1.4572, 99 per cent	1.4580, 95 per cent	1.4573, 98 per cent.
Alcohol recovered:			
Weight	50 grams	49 grams	82 grams.
Mols	0.68	0.66	0.93
Product washed with water:			
Weight	243 grams	267 grams	207 grams.
Acidity (as per cent oleic)	2.4	2.3	2.8
Product washed with alkali, weight.	214 grams		
Product distilled:			
Weight	187 grams	250 grams	176 grams.
Acidity (as per cent oleic)	2.6	3.4	2.8
Residue in still, weight	16 grams	11 grams	23 grams.
Distillate washed with alkali:			
Weight	155 grams	189 grams	154 grams.
Refractive index, $n/30/D$	1.4573	1.4569	1.4569
Acidity (as per cent oleic)	0.33	0.16	0.11
Specific gravity, 30/30	0.901	0.897	0.894
Optical rotation, 10 centimeters/30/D	33.6°	36.1°	32.9°

PRESENT METHOD OF PREPARATION OF CHAULMOOGRA BUTYL
AND AMYL ESTERS

Chaulmoogra *n*-butyl esters have been used experimentally for a short time by the medical staff and appear to be less irri-

tating than the ethyl esters, although it is not yet certain that they can be used to replace the latter. Chaulmoogra *iso*-amyl esters are also being tried. The preparation of the butyl and amyl esters is exemplified in Table 8. The method is very similar to that used for the routine preparation of ethyl esters, but the excess alcohol is removed by steam distillation as described in the preceding section. The simplest way to remove water from the upper layers thus secured is to distill fractionally through a column.

TABLE 8.—*Routine preparation of chaulmoogra n-butyl and iso-amyl esters.*

	Designation of run.	
	Butyl-3.	Amyl-3.
Chaulmoogra oil	2,000	2,000
Alcohol	1,000	1,200
Sulphuric acid	10	12
Heated	35	48
Temperature	85	85
Refractive index $n_{30/D}$	1.4589	1.4593
Product steamed:		
Volume	2,020	2,460
Acidity (as oleic)	4.4	7.0
Alcohol recovered	375	525
Distillate:		
Volume	1,835	1,900
Acidity (as oleic)	4.0	7.3
Residue	283	265
Distillate washed with alkali	1,555	1,250
Fatty acid recovered	125	561
Sterilized ester:		
Acidity (as oleic)	1.3	0.67
Optical rotation, 10 centimeters/30/D	37.5	35.1

SUMMARY

1. Experiments on the preparation of chaulmoogra ethyl, propyl, butyl, and amyl esters are described, in which the course of the reaction between chaulmoogra oil and the alcohol was followed by means of a refractometer.

2. The proportion of 2 mols of the alcohol to one molecular equivalent of chaulmoogra oil was found to be sufficient for a practical conversion of the oil into the desired ester, using sulphuric acid (0.03 mol) as catalyst.

3. Hydrochloric acid (0.03 mol) was found less desirable as a catalyst because it caused a different equilibrium value, presumably through different distribution in the two liquid phases.

4. Practical equilibrium was found to be obtainable by boiling a few hours, using dehydrated alcohols.

5. The water in 95 per cent ethyl alcohol was found to emphasize the separation of the reaction mixture into two layers, which disadvantage can be overcome by increasing the amounts of alcohol and acid and the time of boiling.

6. Methods used at present for the preparation of chaulmoogra ethyl, propyl, butyl, and amyl esters are described and characteristics of these products are given.

7. A method is described for combining the ethyl esters with iodine in such a way as to diminish materially the irritating properties of this drug.

ILLUSTRATIONS

PLATE 1

- FIG. 1. Manufacture of chaulmoogra ethyl esters. The reaction is taking place in the two concrete tubs which have condensers attached.
2. Distillation of chaulmoogra ethyl esters. A reserve still, without covering, is placed in foreground to show construction.

TEXT FIGURES

- FIG. 1. Experimental preparation of chaulmoogra ethyl esters.
2. Experimental preparation of chaulmoogra propyl esters.

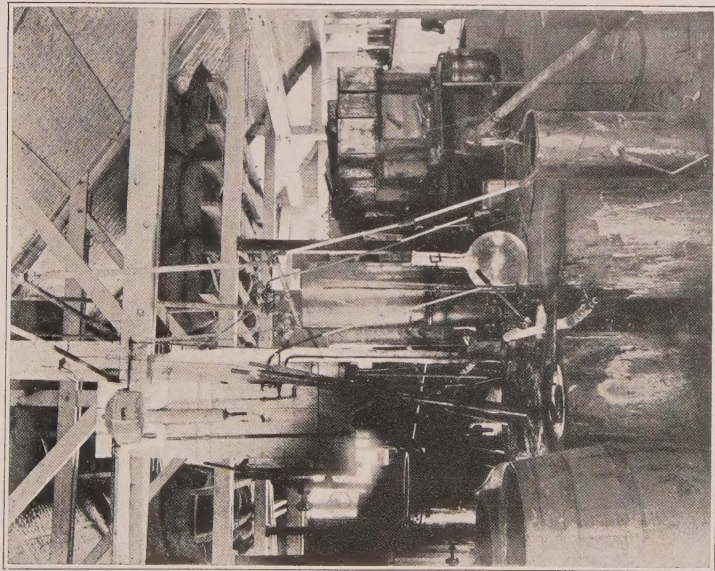


Fig. 1. Manufacture of chaulmoogra ethyl esters. The reaction is taking place in the two concrete tubs which have condensers attached.

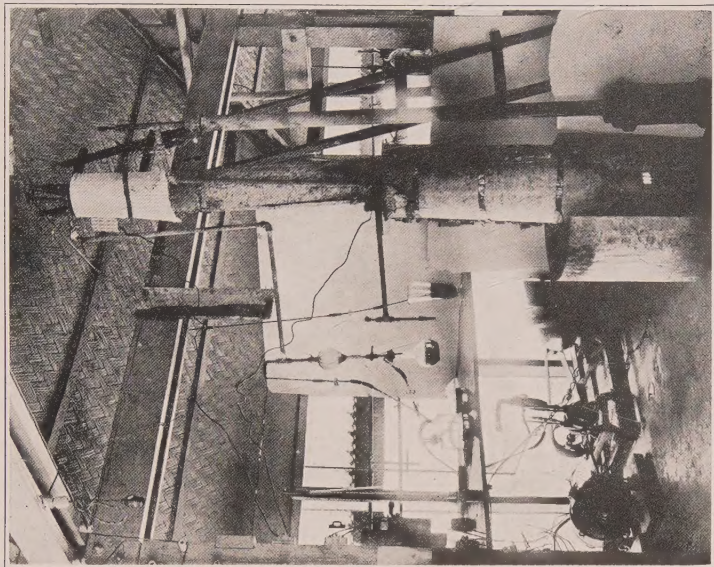


Fig. 2. Distillation of chaulmoogra ethyl esters. A reserve still, without covering, is placed in foreground to show construction.

PLATE 1.

